

Certifying Web Accessibility for the Handicapped by ISO 9241 conformance testing

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Abstract: Software-ergonomic evaluation is aimed at assessing a system's degree of usability. The criteria of the evaluation can be established in several ways, e.g., by a theory or standards. The European Union (EU) published the directive 90/270/EEG concerning the minimum safety and health requirements for VDT workers (EEC 1990) to establish common working conditions for users of visual display terminals. The national governments participating in the EU have transformed this directive into national law. The international standardisation activities of ISO 9241 concerning ergonomic requirements for visual display terminals form the basis which define the relevant technological requirements necessary to fulfil the directive. In this paper, an expert support method for evaluating user interfaces according to the ISO 9241 standard is presented and applied to a web tool's accessibility assessment for end-users with special needs.

1. The ISO 9241 Standard

ISO 9241, the "Ergonomic requirements for office work with visual display terminals (VDTs)", is far from being a pure technical standard that can be assured by quantitative measures. Rather, it requires interpretation and tailoring to be useful in user interface evaluation and reflection about the state-of-the-art technology in research and development. It is subject to an ongoing process of discussion and bargaining, and it has to successfully pass through several stages of negotiation and acceptance. Different expertise and interest influence the results, and they establish a "minimum level of user oriented quality" [Dzida 1995].

With regard to ISO 9241, part 11, the software-ergonomic evaluation of usability has to be placed in the natural context of use consisting of the users (e.g. their software-, hardware- and task experience, their age, sex, intellectual and physical capabilities and disabilities), their tasks, applicable hard- and software and the organisational and physical environment. Although usability is a property of the overall system (e.g. the WWW), the focus of attention is usually on a specific element within the overall system, in our case, the webbased telecooperation environment BSCW.

1.1 *Structure and Methodology of the ISO 9241-Evaluator*

The ISO 9241-Evaluator [Oppermann 97] supports the conformance test of a given application with ISO- 9241, part 10 to 17. The evaluation procedure is based on EVADIS [Oppermann 92], an approach being designed to support the ex-post evaluation of a user

interface that is now open to being used for evaluations of interfaces under development (prototypes etc.).

The ISO 9241-Evaluator is a guideline oriented expert-based evaluation method that prepares the requirements of the multi-party standard ISO 9241 to be tested in about 450 test items. The test items are structured in a two dimensional space defined by technical components and software-ergonomic criteria. The dimension of the technical components is inspired by the IFIP model for user interfaces [Dzida 83; 1988], extended and adapted to the structure of the multi-party ISO standard. The second dimension consists of the software-ergonomic principles—based on the dialogue principles of ISO 9241, part 10 and extended by requirements for the presentation of information, ISO 9241, part 12. Each test item checks a particular aspect of ergonomic requirements specific for the given component and criteria. The structure of the test items is illustrated in figure 1.

The ISO 9241-Evaluator is a subjective evaluation method because the expert examines and answers questions according to his or her personal assessment. However, the Evaluator is also objective because the ergonomic requirements are operationalised and precisely formulated, thus enabling the evaluator to answer questions based on clear test rules and traceable conditions.

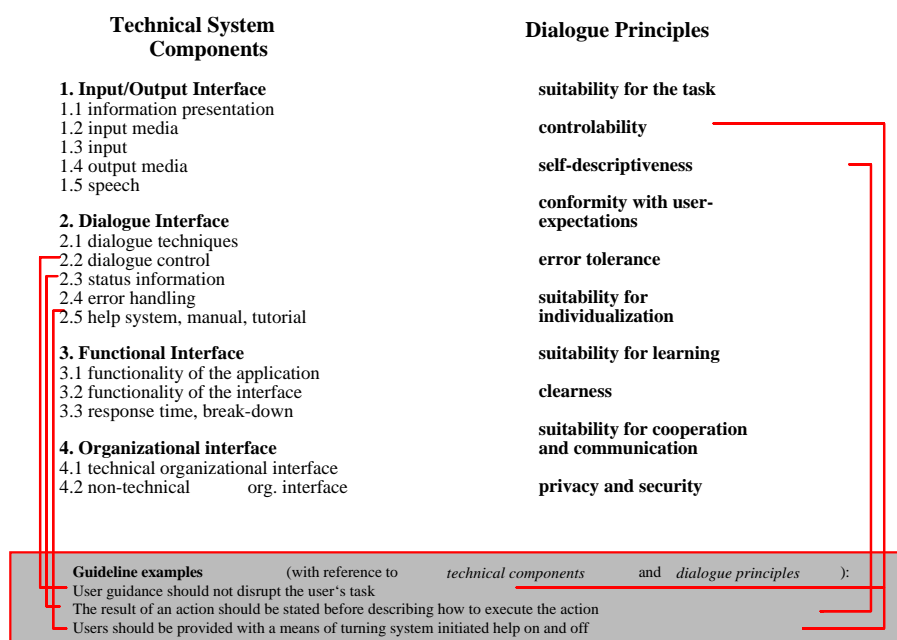


Figure 1: Three example test items for technical components and dialogue principles

1.2 Evaluation Software

The ISO 9241 Evaluator can be applied with a supportive software. The software runs on a PC under Windows. All components of the evaluation method (for example, technical components, software ergonomic criteria, and test items) are stored in a relational database. The software package supports the evaluator during the whole evaluation process and provides an assessment summary. The evaluator specifies and records the test situation(s) for each test item, evaluates each test item for the (several) test situation(s), writes an explanation

of his or her evaluation, and can capture detected deficiencies. Test results in form of ticked check boxes, verbal comments and defined ratings can be exported to a text editor and a spreadsheet to produce the final evaluation report.

The evaluation can be aimed at the evaluator's or designer's particular interests by what we call "views". With the help of views, the evaluator can define a subset of test items that is relevant for the evaluation. Standard views are prepared for ISO-parts, dialogue principles, attributes of presented information, technical components (ISO reference model) and so-called meta-items¹. The definition of views is supported by a view editor that allows for specific views according to particular interests and aims of an evaluation, e.g., special needs accessibility.

The views (in particular self defined ones) allow the specialist to create an efficient environment for repeated occasions of evaluation in composing a special repository of test items.

A selected view on web accessibility for the motor-impaired has already been derived from ISO 9241 with regard to the software-ergonomic criteria *clearness* of the graphical user-interface and *self-descriptiveness* of the overall system. The evaluation procedure however did not rely on the Evaluator as a guideline oriented expert-based evaluation method but rather involved real (handicapped) end-users into an experimental design based on constructive interaction methodology [MIYAKE 1982]. Because a possible disadvantage of the ISO 9241 Evaluator is that the judgement is not user-based and the final statement can be biased to a certain degree by the assessment of the expert, it could be meaningful to prove validity and reliability of the ISO 9241 Evaluator by comparing it with results being derived from different methodological approaches.

2. A Selected View: Accessibility of the Telecooperation Environment BSCW 2.0 for the Motor-Impaired

The telecooperation system BSCW (Basic Support for Cooperative Work) version 2.0 "GermanBig", offering the feature of blown-up instead of regular-sized icons, was subject of this evaluation (<http://bscw.gmd.de>). This feature is especially useful for people with impairments in the upper limbs since it enables this group of users to operate the system by mouse or alternative input devices like a headmouse.

¹ Meta-items summarise a set of detailed test-items for a given ISO-part and a given dialogue principle. 50 meta-items have been defined so far to allow for a short assessment of a user interface and prepare a detailed analysis to be conducted only in critical parts of the interface identified by the results of the meta-items.



Blown-Up Icons



Regular-Sized Icons

2.1 Methodology

The methodological design of the investigation involved objective as well as subjective methods. During the investigation a logfile was recorded containing information about user behaviour as type and frequency of mistakes. After the subjects had finished working with the system practically, a standardised questionnaire enhanced by a few items was distributed rating the functionality and the suitability for the task of the system by scales with bipolar stated items. However, the main part of the investigation was designed following the so-called method of “constructive interaction”. It consisted of presenting the two subjects, a severely physically handicapped and a nonhandicapped one, a well-defined task asking them to achieve this task co-operatively and articulate as much of their thoughts as they can. The interaction of the two subjects with the telecooperation system as well as their discussions were video-taped.

The advantage of this method consisted in eliciting a “natural” communicative situation while talking about a piece of software. The problem of functional fixedness as well as frustration caused by not achieving a task could be counteracted by this method, because there was always social reinforcement available. However, some disadvantages became also apparent mainly due to the fact, that subjects first have to develop a strategy on how to cooperate with each other. They have to match their strategies for problem solving for instance. In this case, they appeared to be rather different (systematic-structured vs. explorative-intuitive style).

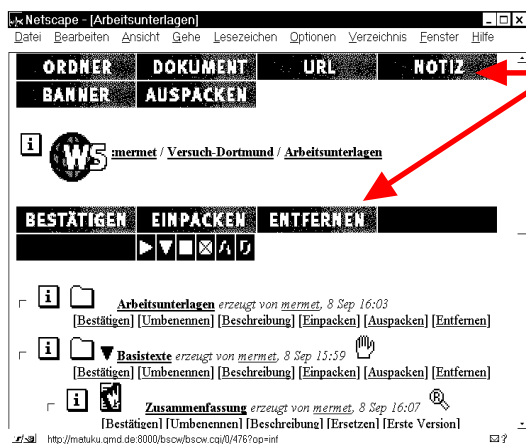
The task presented to the subjects was constructed according to a typical teleworking process. The subjects were asked to proof-read a text and enrich it by a provided picture, so that they had to develop a new lay-out of the text. Afterwards, they were asked to import the text into the teleworking environment and attach a note concerning their design decisions. As a reply, they received an answer and new instructions via the teleworking system. While achieving the tasks presented during these processes, the main functional body of the teleworking system needed to be employed, so that ergonomic criteria as suggested by ISO 9241 could be evaluated. However, the main attention during the evaluation of the conducted investigation was directed towards the ergonomic criteria clearness of the graphical user-interface and self-descriptiveness of the system.

2.2 Summary of Findings

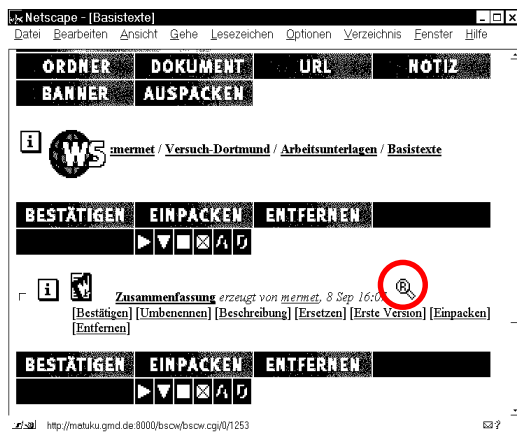
First of all, the findings of the investigation showed, that featuring BSCW with blown-up icons for teleworking purposes facilitated navigation by mouse for the severely physically handicapped subject significantly as this person was able to select all icons intentionally and readily by a standard mouse. However, there is a trade-off between facilitating navigation by icon enlargement and reduced overview of the workspace, since the user is only presented a small part of the entire content of the workspace. Thus, it is very difficult to build up a mental model of the workspace necessary for navigation. Maybe an additional function should be provided showing the content of this workspace as a whole.

For the screen design of such an additional function perceptual deficits occurring particularly within the group of people affected by a physical impairment due to brain injury need to be considered. This concerns mainly the differentiation of figure and ground, recognition of the integral whole as well as form analysis and - synthesis.

For instance, in BSCW all operations possible to carry out with a document are listed directly under the name of the document. The list of operations consists of about seven items, therefore, the operations need to be written rather close to each other. Additionally all options are put in brackets and are underlined. Figures like these are hard to dissolve for people suffering from perceptual deficits.

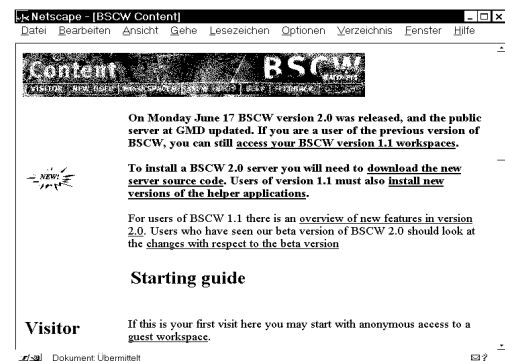


Furthermore, due to the icon blow-ups, the icons on the header are dominating the graphical user interface to the degree, that during the evaluation, the two subjects tried again and again - although unsuccessfully - to execute operations referring to a certain document with the operations listed in the header rather than the operations listed right below the document. Employing a more balanced „look and feel“ screen design would counteract this problem.



Additionally, it took a while for the icons representing the awareness-symbols to become apparent to the subjects. One reason might be the perceptually dominating impression of the header, however, in case only a few symbols appear on the screen, they do not seem to elicit awareness.

The German version of BSCW also does not offer help texts written in German. They are only available in English. The same refers to the homepage of BSCW which the user needs to pass in order to enter a workspace. This presents an important obstacle for people with little knowledge of English, particularly among the group of handicapped people.



Finally, the communication channels provided in BSCW version 2.0 seem to be sufficient for exchanging short working orders and comments about the work. For decision finding processes, however, additional communication channels allowing for synchronous communication should be available. The new version of BSCW, BSCW 3.0, which has been recently released offers the opportunity to communicate with one another by scheduling audio-visual meetings on the basis of CU-SeeMe™.

3. Future Plans

In the future, GMD's HCI research division plans to strongly support the recently launched "Web Accessibility Initiative (WAI)" of the World Wide Web Consortium. To promote and achieve Web functionality for people with disabilities, WAI will develop corresponding software protocols and technologies, create guidelines for the design and use of special needs interface adaptations and technologies, and inform the industry. GMD's ISO 9241-Evaluator project will be part of the WAI Working Group on Rating and Certification Software. Under this umbrella it will closely cooperate with the "Center of Information Technology Accommodation" (CITA) of the US-government's General Services Administration (GSA) in Washington, DC. Initial review would explore the reliability of selected views of the ISO 9241-Evaluator in conformance testing of access-relevant attributes of WWW browsing and authoring tools for end-users with special needs. This work also contributes to the objectives of the WAI Working Group on Guidelines and Style Guides. In the future, the ISO 9241-Evaluator may offer particular benefit as a product comparison tool for buyers responsible to

user groups (i.e. users with disabilities and nomadic users) unable to adapt to IT products that are not ISO-compliant.

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