Usability Engineering as an Important Part of Quality Management for a Virtual University

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ABSTRACT

The paper describes an integrated approach on how to implement quality management regarding the special usability of learning modules while building a virtual university. The approach is based on a simplification of the official German accreditation standard for testing and certifying the usability of software products. This standard had to be decreased in complexity in order to fit into the specific conditions which characterize the organization and the time schedule of the project. The paper shows how deficits in the context of use analysis could be overcome by an iterative approach. Some preliminary evaluations of the usability of precocious realized „pilot modules" of learning material were already carried out. Results based on empirical data from questionnaires and observations in user tests are reported; they served as feedback in order to refine the quality management concept under construction.

Keywords

Distance learning, usability evaluation, quality management, empirical evaluation results

INTRODUCTION

The situation

The work we describe has been done within the context of a project called "Virtual University of Applied Sciences" (Virtuelle Fachhochschule - VFH), which intends to built a "location independent" university during the project period of five years. Its organisation is based on a consortium of 12 different universities or educational institutions, most of them located in the northern part of Germany. The virtual studies will start with offering a curriculum for computer science of multimedia systems as well as for business engineering. Students may take a set of courses for the Bachelor/Master degree or select single courses from the virtual curriculum to complement their traditional studies. The focus of interest lies in computer-supported multimedia-based teaching and the production of learning material which offers distance learning to students dispersed all over Northern Germany.

One of the important characteristics of the VFH-project is that not only are the students scattered all over Germany, but also the teams of developers working at the teaching material are located at the different universities and they also follow different procedural models of software development. There are mainly two different kinds of teams in this project: The production teams, which plan and implement the different courses and the support teams which offer assistance and advice to the producers, but also perform quality assurance functions with regard to didactical, ergonomical and technical aspects.

The purpose

A whole set of different approaches aimed at increasing the usability of learning modules was elaborated and each of these are still undergoing further improvement based on empirical testing in the project. The set of measures comprises:

- An ergonomics manual with a basic general introduction for developers of learning materials into topics of usability and ergonomics
- Special usability training seminars for developers, conceptioners and managers of production teams
- Individual support for teams producing particular learning modules by means of dedicated reviews and advice
- An integrated „styleguide" which covers different types of requirements (didactical, technical, formal) and provides a strong focus on software ergonomics (usability)
- A procedure that allows to transfer (from the application software domain), implement and refine a quality management process with usability as a key quality factor
- Evaluation of not only the final products (i.e. the learning modules) but also the documentation of the preceding process (i.e. description of goals, requirements user groups), using reviews, usability testing and questionnaires.

DESIGNING THE PROCESS

Quality management, especially in a project of this size, needs a well defined process as a guideline for all participating parties. It has been one major task of the usability team to implement a procedure which is suitable to enhance and even to enforce the usability of the products, namely multimedia learning modules for the use in this virtual university.

Transferring standard software usability methods to the context of CSCL

As a starting point we chose the approach on usability testing as described by the German accreditation office DATech as common ground. For usability certification (according to ISO 9241) in Germany the German accreditation office DATech has developed and published a testing manual for the usability of software products (see [2], [3]). The main idea of this approach is to closely connect usability tests and reviews to the original context of use by defining a comprehensible and reliable method on how to extract usability requirements from use scenarios. We chose to follow the basic ideas of this approach even though we had to make a lot of concessions to the real world problems of the VFH-project, i.e. especially the lack of sound analysis data and resources. We call our subset of the complete "heavyweight" DATech evaluation and certification the "lightweight" approach.

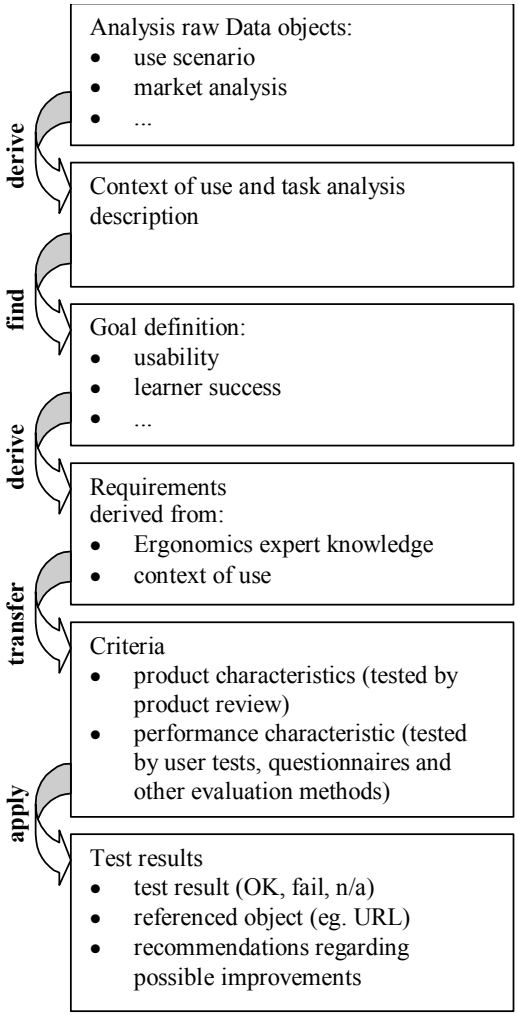

Figure 1: Applying the DATech Approach in the field of CSCL-module production

The production of learning modules differs from the development process of "common" application software, but there is a basic similarity in the general idea of usability being the outcome of a situation, where the user can achieve his/her aims with a given system effectively, efficiently and to his/her satisfaction. The difference is that effectiveness and efficiency in our case are related to the more complex task of "learning" than just to plain tasks like "writing a letter". Nevertheless all three factors can be verified and used as a basis for empirical usability testing. Figure 1 shows the possible transfer of a comprehensive usability testing approach into the world of CSCL-module production. In our lightweight subset the analysis data, the description of the context of use and the goal definition were minimal in the beginning and are now being refined using results from testing students actually doing their studies by learning with the modules.

An iterative approach

The main problem was that there were no realistic use scenarios in the beginning. Existing scenarios did not cover the intended user groups and the specific goals of a university of applied science in contrast to a general university. To avoid a life-lock between the wait for scenarios and the need to start with building modules - which were the base for the description of the scenarios - an iterative approach was taken, where in a first stage at least the general requirements were defined, which were refined in the project's progress (see figure 2).

Stage 1: Setting up general requirements and teaching usability to the producers

In this kick-off-stage requirements were mostly ascertained by transferring general software usability principles (like defined in ISO 9241 part 10 and 11 [8]) into the context of CSCL. The most important issue during this transfer is to keep in mind that unlike "normal" software use the fastest and/or easiest way is not always the desirable way for a learning content. Therefore, decisions were made in a tense cooperation with a team of education scientists which is specialized on didactics of online learning.

The conceptioners and producers of the early modules were then specially trained in basics of ergonomics and didactics and closely attended by the supporting teams. A general usability manual and didactical materials documented this for the participating team members.

This approach had two major deficits:

- It implies a lot of transfer work for the producers and conceptioners as well as a whole lot of advice for the supporting team. This would have been impossible to continue through the whole project.
- As described in [1] such solely expert based approaches will not find all the major problems. There is anymore need for corrective feedback from the users actually using the modules.

Therefore, this could only be a starting point in order to get some prototypes up and running for more intense and realistic on-site testing. Possible differences in usability quality of early modules compared to later modules were accepted for the pilot phase and the modules were improved later.

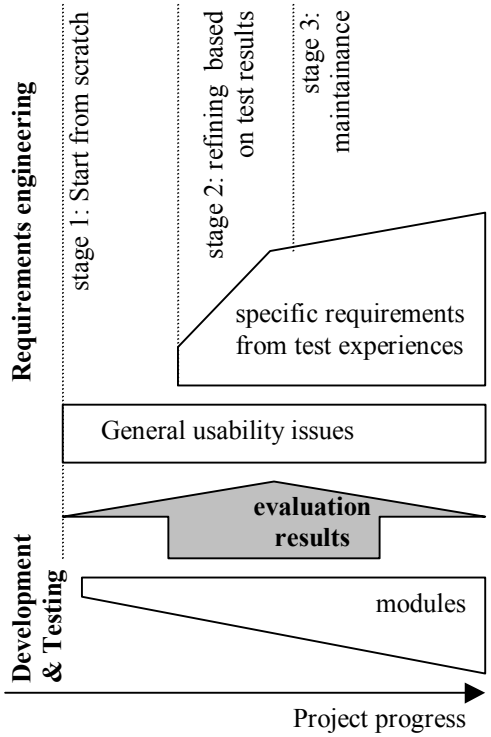

Figure 2: Getting started in spite of still incomplete analysis and open questions

Stage 2: Refining the requirements using usability tests and questionnaires

Instead of relying on the analytic work done so far, we started to live up the "leightweight" version of the scenario to criteria approach from the DATech model (see figure 1). As a concession to the limited time and resources we had to parallel the testing of prototypes with the ascertainment of scenarios. Furthermore, we had to shorten the scenario analysis to a minimum and to very small scenarios. We know about the limitations this implies and will broaden the scenario base step by step. But the main idea is still here: Every requirement can be traced back (at least implicitly) to a generic usability requirement (like readability of text) or a special context of use characteristic (like navigational issues) and we enable all teams to comprehend why a criterion is needed. This was essential, as many of the participating teams had strong opinions (eg. design issues) on how to plan and design the modules. The usability team could only convince with a complete decision chain like in the DATech model. In this second stage the pilot modules are tested under more and more realistic conditions

When typical users were available, usability tests took place at home of the potential students. It was done with four modules with 3 to 5 persons per module. Additionally all potential students were asked to answer a questionnaire which was specially developed for this purpose (described later in this paper).

The test results were used to give feedback to the project specific design guidelines: The "styleguide" and the "process guideline" which are described in detail below. During the tests the workflow of the typical virtual students was observed and documented. There is a interdependency between the offered module and the workflow which had to be eliminated as far as possible by comparing the different approaches of the different modules. Having done this, there is still a wide range of design possibilities that have not been analyzed yet. They are not already covered by this process but can fit in to any later point as they appear. The process is explicitly open for new ideas and findings.

Stage 3: Maintenance of the requirements

After the project had passed through stage 2 the pressure rose to start developing and producing modules for real use. So the requirements were consolidated as far as possible and the "mass production" of 35 modules could begin. In this stage changes to the process documents and new requirements have to be looked at very carefully in order not to overturn already complete modules. On the other hand the necessary iterations must be allowed. To overcome this dilemma modules do not necessarily have to fulfill requirements that emerge during or after their development event, though an improvement is advised. This way the quality management working group is free to carefully revise earlier decisions if needed.

The project "styleguide"

The development guidelines (historically but incorrectly called "styleguide" in the VFH-project), with well defined requirements regarding the didactical, the ergonomical and the technical issues, are the backbone of the quality management process as they define criteria to be met. In the following we focus on usability issues.

The guideline is formulated like an ISO Standard and all requirements are classified as MUST, SHOULD and CAN. Classification is done with respect to the possible harmfulness of a rule violation. Rules defined as "MUST" are seen as a fundamental basis and the possibility that they might be overruled by later findings is minimal. Producing teams are not allowed to disregard these rules. If a rule is classified as "SHOULD" people are allowed to deviate as long as they prove that the alternative is at least not worse than the originally proposed solution. This leaves enough room for new ideas not yet covered by the"styleguide". If something is classified as "CAN" it is just one possibility proposed but it is not quite sure that it is the best one. MUST and SHOULD requirements define (usability) necessities whereas CAN-items are intended as a voluntary assistance and have no committing effect.

In practical use the guideline is seen as a helpful and constructive development aid instead of a hindering commitment. Most of the producing staff had asked for such a guideline even before it was planned and felt

relieved to finally get some guidance on how to handle standard problems so they could focus on more special ideas. Of course some requirements were less popular, for example those related to the use of frames and bookmarks as they implied limitations or extra work.

The process guideline

After the styleguide was published internally, there was a need for a transparent way of applying the styleguide in the production process. The participating parties (authors, conceptioners, designers, multimedia producers and of course the support and review teams in the fields of didactics, ergonomics and technology) had to know *when* to ask *whom what kind* of questions and *which* documents had to be delivered in order to prepare the advice. Until then support was often requested too late when most work had already been done and decisions got rather irreversible. The support teams complained that they had to derive (reverse engineer) relevant data like didactical or use concepts from prototypes.

The process guideline is intended to close this gap between the requirements in the styleguide and the problems that arise from the cooperation of different teams. As a concession to the time and resource constraints the typically 6-8 different phases known from the software development were combined into four major stages:

1. Analysis and Concept phase: The authors and their conceptioners develop a plan on how to present the learning content in using the new media. This is documented in several defined concept forms. The concept peer review is done by didactical, CSCW and domain experts.
2. Design and Prototype phase: Now designers and conceptioners work out a proposal for the implementation of this learning module. This proposal is realized as a documented prototype. During this phase the designers are encouraged to use the advice offers from the usability and the technology team. At the end of this phase the designers evaluate their concept with respect to the styleguide requirements and this self assessment is then reviewed in combination with the prototype by the technical and usability support.
3. Implementation (Production) phase: In this phase the production teams start to do what was planned in stage 1 and 2. Ideally all questions were answered in the preceding stages but of course all support functions are available to step in if needed. All supporting functions have to review the result again in order to find deviations from the already reviewed concepts. Due to time limitations this is normally done as a spot test.
4. Deployment phase: The use is evaluated using questionnaires, usability tests, interviews and other means and is the most valuable input for the maintenance of the quality requirements defined in this project.

Following the ideas of iterative design, each stage, especially the first and the second, are repeated unless satisfactory review results are reached (see [7]). Furthermore a step back to stages already passed is possible if severe problems arise in a later stage. The aim of the whole process is to limit such expensive roll-backs to a minimum.

SOME PRELIMINARY RESULTS FROM THE USABILITY QUESTIONNAIRES AND TESTS SO FAR

Questionnaires

In order to test the usability of the pilot modules in terms of students' ratings a questionnaire was developed which consists of a whole series of items related to different important aspects of usability, which can be used as six summarizing scales:

1. **Orientation** (7 Items)
   Different basic aspects of being always well oriented on where in the module the learner arrived; what is to be expected or should be done; not to get lost in hyperspace.
2. **Presentation** (10 Items)
   Regards the presentation of the learning material, like readability, meaningful organization of pages and their sequence, use of multimedia and similar problems.
3. **Navigation & Control** (6 Items)
   Basic aspects of navigation support and giving control to the user.
4. **Learnability of Navigation** (8 Items)
   Different functions which minimize the learning effort necessary before the software system (module) can be used intuitively.
5. **Learning Support** (11 Items)
   Essential functions which support the mastering of the real learning task at hand , including feedback on learning progress and communication with other learners.
6. **(Support for) Individual Learning Strategies** (10 Items)
   Different aspects of giving the learner the means to plan and organize his/her own preferred ways of learning, repeating, making annotations and going ahead.

The sequence of items in the questionnaire itself was random and not grouped according to the described underlying structure. All items are related to the requirements documented in our 'styleguide'. Each item is formulated as a statement of the following general form "Regarding the module I worked with it can be said that..." and subsequently a specific usability attribute, e.g. "... I always know where I am", "... colors and highlightings have a consistent meaning" etc.. Furthermore, each item has to be rated with regard to two different aspects: (a) The *importance* of the respective attribute in principle, i.e. what should apply to *every*

module (4pt. rating scale, 1=very important ... 4=unimportant). (b) The *satisfaction* of the student regarding how the attribute has been well applied to the specific module he used for his studies (5pt. rating scale, 1=very satisfied...5=very dissatisfied).

Our sample of students of pilot modules who answered the questionnaire includes N=52 persons, with about 33% female, about 52% in the age group of 30 and more years, and above 75% with an apprenticeship certificate before studies. So it seems to be a relatively small but nevertheless representative sample of the population or target group which the VFH-project intends to recruit as students in the future.

Seven pilot modules were used and evaluated by the students. Most of the modules belong to the studies in business engineering, and some to studies in computer/multimedia science. Due to the fact that every student evaluated only one specific module we have very small subgroups if we would intend to compare and discuss mean values of satisfaction, whereas importance ratings are per definition independent of a specific module. However, the present paper intends to give only the overall picture of what has been already achieved by our ergonomic advice, the styleguide and reviews, which are part of the described quality management cycle. Additionally, the general principles underlying the application of our questionnaire are to be demonstrated.

In Figure3 the mean values of all items regarding the importance as well as satisfaction ratings are shown in a combined bar and line chart. Within each scale (group of items) the associated items are ordered according to their mean importance rating. So, if mean values of satisfaction would be regarded as "still not sufficient" and if time and resources are restricted, this kind of ordering might be a basis to decide upon what should be clarified and redesigned first and what might be postponed.

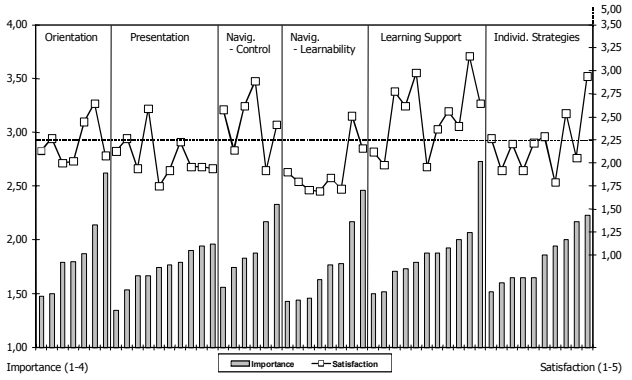

Figure 3: Mean values of all items with regard to (a) Importance (bar chart; y-axis left-sided) and to (b) Satisfaction (line; y-axis right-sided). – *See text for further explanations*

Scale	Var.	WS1	WS2	WS3	WS4	WS5	WS6
Orientation	WS1		.29	.37*	.18	.20	.26
Presentation	WS2			.52**	.60**	.58**	.55**
Navig-Control	WS3				.40*	.45**	.38*
Navig-Learnability	WS4					.45**	.33*
Learning Support	WS5			Importance Ratings			.48**
Individ. Strategies	WS6						
Orientation	ZS1	.05	.16	-.03	.22	.08	.17
Presentation	ZS2	-.03	.27	-.05	.22	.18	.29
Navig-Control	ZS3	-.00	.12	-.18	.21	.09	.03
Navig-Learnability	ZS4	-.08	.16	-.00	.15	.15	.21
Learning Support	ZS5	.13	.19	.21	.05	.14	.26
Individ. Strategies	ZS6	-.05	.21	-.11	.25	.18	.10

		ZS1	ZS2	ZS3	ZS4	ZS5	ZS6
Orientation	ZS1		.61**	.69**	.64**	.68**	.67**
Presentation	ZS2			.56**	.59**	.58**	.55**
Navig-Control	ZS3				.48**	.46**	.73**
Navig-Learnability	ZS4					.44**	.56**
Learning Support	ZS5			Satisfaction Ratings			.59**
Individ. Strategies	ZS6						

Figure 4: Correlation matrices of the six usability scales with regard to Importance and Satisfaction (significance * p<.01, ** p<.001). Matrix in the middle contains the correlations between importance- and satisfaction-related scales.

In looking first at the bar chart which represents the importance ratings, it can be stated that with mean values ranging from 1.35 (Presentation, 1st item) up to 2.73 (Learning Support, last item) most of the usability attributes are rated from the students' point of view as "very important" or "important", because mean values of 2.00 or less are the majority. This demonstrates that all in all the students agree with our (experts') opinion, based on which we composed the questionnaire. Moreover, in *every* group of items (scale) there are some which belong to most important, and none of the different aspects of usability seems to be more or less unimportant to the students.

Now, in regarding the line which represents the satisfaction ratings (value axis left-sided), the first impression is quite positive: Mean values range from 1.69 up to 3.16 and demonstrate that the students seem to be quite satisfied with what already has been done to assure the usability of the modules.

However, this generalized positive impression must be modified. First, we have to take into account that ratings of satisfaction are biased by a positive tendency. People do not like a negative view, especially on things in which they have to invest a good many of their effort (cf. [4] for the theory of 'cognitive dissonance'). The second argument is directly derived from our work and our responsibilities in the usability team. Ratings of 3 and above on the 5pt. satisfaction scale should be a rare exception. From this point of view mean values of satisfaction above the dotted line in Figure 3 suggest further usability improvement endeavor. It can be seen that a relevant number of the values meet this condition, especially most of the items representing the scales of Learning Support and Navigation-Control. In order to identify the reasons and to give advice for improvements we have to undertake a detailed analysis of the measures for the different modules. However, this cannot be demonstrated within the limits of this paper.

Finally, the correlation matrix for the six scales of our questionnaire might be of interest (figure 4). Scale values were computed for every person in our sample in terms of the mean of all (non-missing) item ratings that belong to the respective scale, summarizing this way either the importance (WS1 – WS6) or the satisfaction (ZS1 – ZS6) values. It can be seen that there are important and significant correlations amongst the different scales of

importance (matrix at the top) and even higher correlations amongst those regarding satisfaction (matrix at the bottom), whereas all correlations between importance- and satisfaction-related scales are near to zero. Therefore, it can be stated that these two different judgements concerning usability are really given independently and have no variance in common. There are additional interesting questions in regard of the correlation matrix which we cannot discuss in this paper.

Usability testing

In the VFH scenario students learn for their courses and communicate using their PCs at home. To cover this the usability testing was planned as an on-site test at the students homes. Students were asked to voluntarily take part in the testing and give a time of their choice when they normally use the learning infrastructure. Practice showed that many students felt uncomfortable about being visited at home, so the tests had to be very carefully introduced by their teachers.

Tests were conducted as a combination of a lead-in structured interview followed by an "thinking aloud" user test. To start in a comfortable way the students were asked to describe their context of use and their workflow first, which made them feel more like being interviewed rather than tested. Then a 30 to 45 minute user test was conducted. During this phase the "real" workflow and of course all symptoms of usability problems were observed. Users were asked not to discuss potential usage problems unless the end of this test in order to avoid them pointing just at what they felt was bad. At the end of this test users were again interviewed and now explicitly asked what they thought of the module. Some of them already had worked with more than one module and were asked for a comparison.

Tests were documented in protocols that were given to the developers and used in conjunction with the results from the questionnaires for further requirements engineering.

Some Preliminary Conclusions

The following shows a collection of what questionnaires and testing showed to be amongst the major issues so far.

- **Navigation**
  Not surprisingly questionnaire and testing showed users major concerns regarding their navigation through partially unknown hypertext structures. Here "learning" can be critically hindered by badly designed navigational means and problems with the user orientation. Feeling lost is the worst thing that could happen to a user while trying to study a difficult course. At least the design of the modules should avoid all kinds of irritations so the user can concentrate on the complexity of the content instead of the intricacy of the module handling. Many criteria and requirements are about this concern.
- **Tools for annotation, bookmarking and re-using module contents (Learning Support and Individual Strategies)**
  Many modules contain new ideas on how users could do annotations, bookmark interesting parts or solve tasks. Often the implementation of these ideas proved to be not very helpful because they were difficult to use, even on a regular basis, often caused by technical limitations (e.g. HTML, Java-Script and Java-Applets). From a usability point of view we recommend to support classical working strategies, especially the use of paper, as long there is not offered something at least similar useful. The criteria are the efficiency, effectiveness and user satisfaction compared to a paper and pencil solution.
- **Problems with students' workplaces**
  Visiting students' workplaces showed that most of them had major deficits regarding their ergonomic quality. The main problem was poorly installed and placed hardware (e.g. monitors in front of windows and bad seating and table combinations). In the VFH-project this problem is handled two ways: First, we give students a small guideline on how to set up their work place, on the other hand we do not allow producers to go down to the limits (e.g. of readability). Another important point are the very common interruptions while working at home. The criterion is to allow people to easily continue interrupted work.

OUTLOOK

We now focus on a tool named TAToo to make all the processes and decisions described so far more transparent to the participating teams. Up to now the decision chain shown in figure 1 is available only on individual request and then documented in special "statements". Such statements exist for some frequently asked questions but are far from completion. Our goal is that everybody should be able to easily comprehend criteria and whether these really apply to his special module. If one disagrees with a specific requirement the process of argumentation should be supported by telling the up to now already considered items leading to that requirement.

The main idea is to adopt concepts from the object oriented world (inheritance, abstraction and underspecification) (see [6]) to the field of CSCL production (see [5] and [9]) in order to structure the various information from the whole process (from analysis data to product code). This is done using a XML-based description language, which is stored in a central database. Users have access through a web-frontend (see figure 5), which is accessible using standard browsers.

The tool allows to hierarchically structure the usability relevant data as shown in figure 1: scenario, context of use data, requirements derived from this data and criteria derived from the requirements. These usability objects

can be related to the specific parts of a CSCL-module where the criteria and/or requirements apply. This should enable process participants to find their way from their special problem to the related requirement and, if wanted, back to the roots, i.e. the derivation of this requirement.

SUMMARY

"Getting usability used" as Nielsen stated [10] is a tough job in such a locally dispersed project. Additionally, the special task called "learning" made a careful reconsideration of common usability knowledge indispensable. It seems problematic to start with the production of pilot modules before having a collection of well defined requirements at hand which are derived from analyses of the learners' tasks. Moreover, to start without having a well established quality assurance system might be called amazing. However, the feedback from empirical data collected during the application of these pilot modules under realistic conditions made it possible to undertake already a test, how usability evaluation instruments fit into the quality management concept under construction.

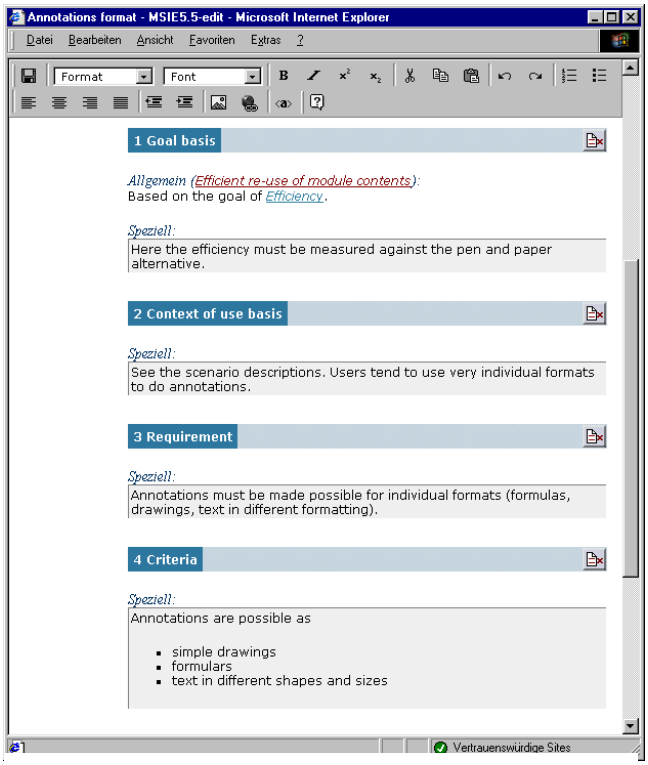

Figure 5: Screenshot from the edit view for a requirements object (example "Annotations format") using the web-browser (IE5.5) front-end

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REFERENCES

1. Dimitrova, M.: "Are Experts Able to Predict Learner Problems During Usability Evaluations?" In: Proceedings of ED-MEDIA 2001. International Conference on Educational Multimedia, Hypermedia and Telecommunications. AACE: Association for the Advancement of Computing in Education, Tampere, Finland, 25.-30. Jun. 2001, pp.1023 -1028
2. Dzida, W. and Freitag, R. (2001): Usability Testing - The DATech Standard. In: Wieczorek, Meyerhoff (Editor): Software Quality - State of the Art in Management, Testing And Tools. Springer. pp. 160-177. ISBN 3-540-41441-X
3. Dzida, W.; Hofmann, B.; Freitag, R.; Redtenbacher, W.; Baggen, R.; Geis, T.; Beimel, J; Zurheiden, C.; Hampe-Neteler, W.; Hartwig, R.; Peters, H. (2001): Gebrauchstauglichkeit von Software Ergo Norm: Ein Verfahren zur Konformitätsprüfung von Software auf der Grundlage von DIN EN ISO 9241 Teile 10 und 11 - Verlag für neue Wissenschaft - Bremerhaven
4. Festinger, L.: A theory of cognitive dissonance. Harper & Row, New York.
5. Hartwig, R.; Kritzenberger, H.; Herczeg, M.: Course Production Applying Object Oriented Software Engineering Techniques. In: Proceedings of ED-MEDIA 2000. Montréal, Canada. AACE; pp. 1627 – 1628
6. Herczeg, M: A Task Analysis Framework for Management Systems and Decision Support Systems. In: Proceeding of AoM/IaoM. 17. International Conference on Computer Science. San Diego, California, 1999 Aug. 6-8, pp. 29-34
7. International Organization for Standardization (1999): ISO 13407 - Human-centred design processes for interactive systems. International Standard
8. International Organization for Standardization (1996-2000): ISO 9241 - Ergonomic requirements for office work with visual display terminals, Parts 1-17. International Standard
9. Kritzenberger, H.; Hartwig, R.; Herczeg, M.: Scenario-Based Design for Flexible Hypermedia Learning Environments. In: Proceedings of ED-MEDIA 2001. AACE: Association for the Advancement of Computing in Education, Tampere, Finland, 25.-30. Jun. 2001
10. Nielsen, J: Getting usability used, in *Human-Computer Interaction – Interact 95,* Chapman&Hall, London; 1995