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Usability Evaluation Methods for a Scientific Internet Information Portal

Jens Hellmers
(University of Bremen, Bremen, Germany
hellmers@iwt.uni-bremen.de)

Jörg Thomaschewski
(University of Applied Sciences Emden/Leer, Emden, Germany
Joerg.Thomaschewski@hs-emden-leer.de)

Eva-Maria Holt
(SEVEN PRINCIPLES, Ratingen, Germany
eva-maria.holt@7P-group.com)

Thomas Wriedt
(University of Bremen, Bremen, Germany
thw@iwt.uni-bremen.de)

Abstract: Sharing information is important for the scientific community. Over the years the internet became the main information source due to its actuality, interactivity and flexibility. While the amount of available data grows, especially non-profit scientific internet pages often lack the user friendliness known from commercial offers, sometimes they also fail to focus on the users' needs. To analyze and improve the attractiveness of internet pages it became common to apply methods of usability engineering. But as it requires a certain amount of work it is usually done in 'big scale' for commercial offers. In this paper we would like to demonstrate the evaluation of a non-commercial scientific information internet portal using methods of usability engineering. For this an online User Experience Questionnaire (UEQ) in combination with web traffic analysis was used. We also would like to outline the experience made during the evaluation process, as well as some of the results.

Keywords: Usability Engineering, User Experience Questionnaire UEQ, Kano model
Categories: H.5.2

1 The *ScattPort* internet information portal

The analyzed internet information source is the portal *www.scattport.org* (*ScattPort*) [Wriedt 08], [Hellmers 09], [Hellmers 10a]. Its editorial content offers scientific information connected to light scattering. The target group consists of scientists from educational and research institutions as well as from industry. The portal contains information about conferences, books, open positions, etc. The main focus of the portal is on simulation software for light scattering. There is information about more than 320 programs [Hellmers 10b] mostly in combination with links for downloads on the corresponding authors' websites.

The page in its present form [see Fig. 1] was established in March 2009 [Scattport 09] and is funded by the German Research Foundation (DFG).

Figure 1: Screenshot of internet information portal ScattPort.

2 Usability Engineering and User Experience

To improve the attractiveness of internet sites it is necessary to understand the users' demands. For this, methods of usability engineering are applied. Nielsen described the assumptions and framework for usability engineering in his popular book [Nielsen 93]. The degree of usability is assessed while the system is used and it is evaluated in regard to effectiveness, efficiency and satisfaction.

It was recognized that improving the usability often is not enough [Hassenzahl 00]. Today, in addition to usability the perception before, during and after the considered use is described as user experience [Hassenzahl 10]. This includes users' assumptions and expectations as well as their emotional bond to the product (in this case the internet information portal). The process of evaluating the user experience is intended to identify possible sources of misunderstandings and thereby allows optimizing the product for the user group.

3 User Experience Questionnaire

To evaluate the user experience of the internet information portal *ScattPort* a User Experience Questionnaire (UEQ) was applied. For this, an established UEQ for product development was adapted [Laugwitz 08]. Technically this was set up as an online questionnaire using *LimeSurvey* [Limesurvey 10] which was linked on the *ScattPort* home page. In addition to the classical evaluation of the user experience via UEQ additional questions were integrated into the online survey. As a result the online questionnaire consisted of two parts, the UEQ and a self-developed section with further questions. It was online between 13/10/2010 and 17/01/2011.

3.1 Questionnaire in practice

First a "dog-eared page peel" link [see Fig. 2] was integrated in the upper right corner of the portal header to encourage users to participate at the survey. In the beginning the response was low, until 5th Nov. 2010 only one user filled in the questionnaire completely. Therefore the front page of the *ScattPort* portal was modified by integrating a pop-up to attract more attention [see Fig. 3]. Setting a cookie made sure that user would see the pop up only once – during their first visit. As a result, until 31st Nov. 2010 31 unique visitors viewed the questionnaire, 16 of these users filled it in completely [see Tab. 1]. By the end of the evaluation period 71 people had viewed the questionnaire, of which 40 visitors completed it.

time span	13/10/10 - 05/11/10	06/11/10 - 30/11/10	01/12/10 - 31/12/10	01/01/11 - 17/01/11
viewed questionnaire	1	31	30	9
filled in questionnaire	1	16	16	7
	pagepeel	pop up		

Table 1: Response to the questionnaire.

Figure 2: Screenshot pagepeel (top right).

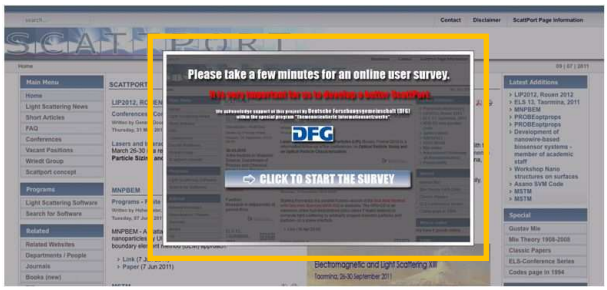

Figure 3: Screenshot pop up.

Users who participated in the questionnaire were asked to rank 26 bipolar items regarding to their personal impressions of the portal on a seven-point scale. For an exemplary illustration [see Fig. 4].

annoying	☐ ☐ ☒ ☐ ☐ ☐ ☐	enjoyable
creative	☐ ☐ ☒ ☐ ☐ ☐ ☐	dull
fast	☐ ☒ ☐ ☐ ☐ ☐ ☐	slow
...	…	...

Figure 4: Examples for items.

These 26 items are assigned to 6 individual key areas: attractiveness, perspicuity, dependability, efficiency, stimulation and novelty [Laugwitz 08]. The ranking of an item on the seven-point scale then is interpreted as a numerical value from -3 (most negative) to +3 (most positive) including 0 (neutral). From these values an average value for each of the 6 key areas (attractiveness, perspicuity, dependability, efficiency, stimulation and novelty) can be calculated – taking into account the grades for all 26 items from all participants. This helps to evaluate the overall impression expressed by the participants.

3.2 Results of the UEQ

The evaluation of the UEQ for the internet portal *ScattPort* could be based on 40 completed questionnaires. For the analysis an Excel worksheet provided by the authors of [Laugwitz 08] was used. The Excel worksheet provides a graphical visualization using a bar chart. By this the individual areas can be rated as positive, neutral or negative:

- Negative: values smaller than -1
- Neutral: values between -1 and +1
- Positive: values higher than +1

Each area is considered and interpreted individually.

For *ScattPort*, the UEQ values differ between 0.462 and 0.962 [see Fig. 5, Tab. 2]. As a conclusion the overall impression of the users about the information portal can be called ‘neutral-positive'.

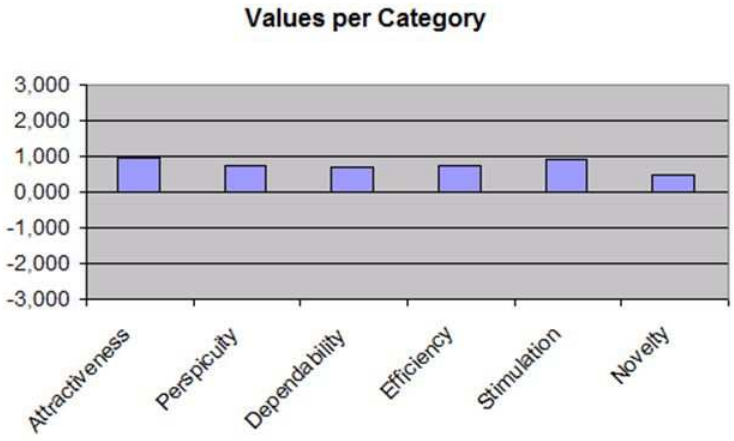

Figure 5: Results UEQ, graphical visualization.

Area	Value
attractiveness	0.962
perspicuity	0.744
dependability	0.705
efficiency	0.737
stimulation	0.929
novelty	0.462

Table 2: Results UEQ, corresponding values.

The neutral-positive score means that the portal basically fulfils the demands of the users. This is e.g. implicated by the value for 'attractiveness', which means that the kind and the amount of content are satisfactory for the users. But there is definitely also room for improvements. To do so the 'emotional' bond between the portal and the users should be strengthened (compare e.g. area 'novelty'), increasing and satisfying their curiosity. By this the 'loyalty' to the portal would be enhanced, resulting in more constant revisits.

3.3 Results for the additional questions

In the second part of the online questionnaire users were asked for their individual impressions and requirements. For an exemplary illustration [see Fig. 6].

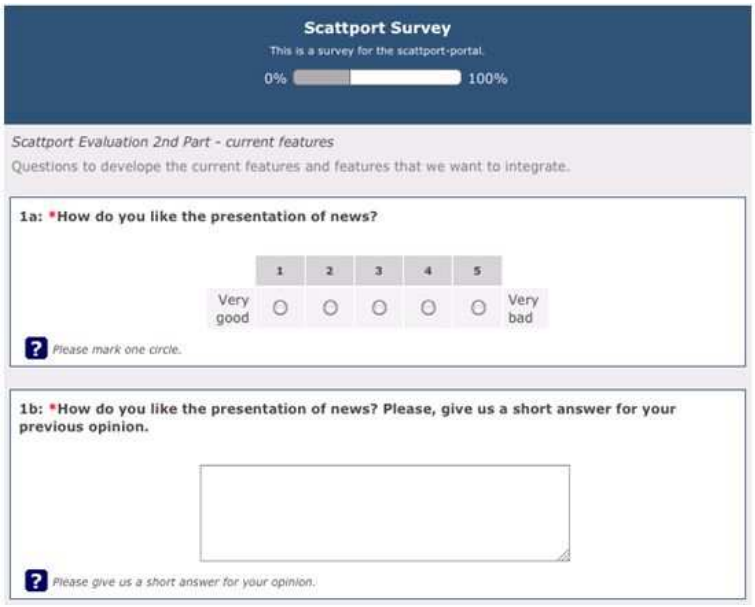

Figure 6: Question in the online survey (example).

Seven questions were structured as follows:

- five questions about the existing content,
- one question about the frequency of use of the portal,
- one question about ways to improve the portal.

For the first five questions users could give a rating on a scale of 1-5, with 1 representing the most positive impression and 5 the most negative. Additionally they could write down remarks to explain their evaluation. For the final two questions the users were asked to write down short statements. A total of 29 participants answered this block of questions.

Next follows a short summary of the questions together with the corresponding results and a summary of the statements.

Social Media Integration

The question: "How would you rate the integration of communication options? (integration of social networking Twitter, Facebook, …)" was answered by 24 participants. They rated the importance of social media integration with an average of

3.08 and a standard deviation of 1.26. This is a ' neutral-negative' result. Of the 24 participants, 20 people added a comment. The analysis of these comments shows also a 'neutral' verdict. The favourable comments mostly included some very specific, individual demands for advanced communications capabilities, which hardly could be applied to *ScattPort*.

Integration Wiki

The question: "How would you rate a light scattering Wiki" was answered by 23 participants. Participants rated this with an average of 2.13 and a standard deviation of 1.30. This is a ' neutral-positive' result. Of the 23 participants, 16 people added a comment. These comments show positive acceptance for a light scattering Wiki. With the exception of 5 neutral comments all participants support the idea of a Wiki as addition to the portal *ScattPort*. Many of them expect improved networking of activities and fruitful discussions. In their opinion it would also help scientists who are not specialized on the topic of light scattering to get started and to get in touch with colleagues.

Motivation to incorporate content

The question: "How high is your motivation to incorporate content into *ScattPort* yourself" was answered by 22 participants. The participants rated this with an average of 2.55 and a standard deviation of 1.12. This is a 'neutral' result. Of the 22 participants, 15 people added a comment. It turned out that 3 people had misunderstood the question completely. 7 participants stress the informative value of *ScattPort*, but regard themselves unable to contribute content, as they feel not competent enough scientifically. 5 participants declare themselves willing to contribute content in principle, but this remains quite noncommittal. Additionally 'lack of time' is stated as another obstacle.

General presentation and use of ScattPort

The question "How do you like the general presentation of *ScattPort* and its use" has been answered by 23 participants. The participants rated this with an average of 2.27 and a standard deviation of 0.86. This is a 'neutral' result that corresponds well with the results of the UEQ. Of the 23 participants, 13 added a comment. The majority was satisfied with the current presentation. An interesting note: 4 participants referred especially to the information about programs offered by *ScattPort* and 2 participants explicitly would like to have online interfaces for the programs.

Presentation of the program lists

The question "How do you like the presentation of the program list" was answered by 24 participants. The participants rated this with an average of 2.27 and a standard deviation of 0.91. This is a 'neutral' result. Of the 24 participants, 12 added a comment. The vast majority expressed satisfaction with the current presentation.

From the responses it can also be concluded that it is not necessary to redesign the software section of *ScattPort*.

Also, some users suggested to store the programs locally on the *ScattPort* server (the listed programs are usually linked to websites of the authors or distributors) respectively they asked to offer the source code. In this case an implementation of such functions is not realistic as authorship and copyright issues have to be respected. Especially commercial, proprietary software which is also listed would be impossible to implement.

Frequency of use

The question: "How often do you use the portal *ScattPort*" was answered by 26 participants. The results are shown in [Tab. 3]. 11 participants use the site often or frequently during the week and therefore can be described as frequent users. 13 participants use the services occasionally or at non-regular intervals. This we would like to call a casual user. Only one user reported that he had never visited the portal before. This means, that the majority of the survey participants knew *ScattPort* well or even very well.

Interval	**Used**
often (usually daily)	6
frequently (2-3 times per week)	5
occasionally (3-4 times per month)	13
never before	1
non-regular intervals	1

Table 3: access rates stated by participants

Suggestions by the participants

Finally, the survey participants were asked to submit their own suggestions how to improve *ScattPort* further. The question: "Do you have more ideas for a better *ScattPort*? Please, give us a short answer" was answered 9 times. Unfortunately only 5 answers could be counted as usable or understandable. From these 5 answers no concrete suggestions for improvement could be deduced.

3.4 Answers to questions in light of the Kano Model

Within the Kano model [Matzler 96] product properties are assigned to individual categories that reflect different impact on customer satisfaction, see Tab. 4 [Sauerwein 99].

category	**impact**	
basic requirement	must be	user expects it, will not be satisfied if fulfilled, but dissatisfied if not fulfilled
performance requirement	one-dimensional	the better it is fulfilled the more satisfied a user will be
enthusiasm requirement	attractive	user does not expect it, will not be dissatisfied if not fulfilled but satisfied if fulfilled
indifferent factor	indifferent	user has no use for it, is neutral
reverse factor	reverse	user expects the opposite
questionable factor	questionable	user misunderstood question or the question was phrased incorrectly

Table 4: Kano model – properties and impact.

The Kano model was not taken into account when this survey was created. Nevertheless, by analysing and sorting the statements given in the additional questions [see Sec. 3.3] it is possible to break them down to generally established Kano wording (see Tab. 4). This helps to separate the statements from each other and as a result it becomes easier to interpret the answers and their possible impacts in regard to the User Experience.

For example: from the users' answers it becomes quite obvious that 'list of light scattering software' is regarded by them as central information offer and thereby the most important part of the portal. It is an aspect users expect to be included. Following Tab. 4 the conclusion is that this is a 'basic requirement'. That makes it a 'must be' function and has to be valued high.

The evaluation of the answers to the additional questions in combination with the UEQ implies that *ScattPort* meets the basic and performance requirements of the users in terms of overall presentation as well as for the presentation of the program lists. The basic requirements get good grades.

It can also be concluded that an integration of a Wiki is likely to increase the appraisal, so it would be an 'one dimensional' impact (performance requirement). On the other hand a Wiki needs an active community that adds and updates content regularly. So, for the estimation of the possible success of a Wiki one has to take into account the statements about the participants' motivation to contribute content themselves. Here, one can see that the users are quite indecisive and their answers are not very encouraging. This somewhat degrades the impact of a Wiki to 'indifferent' and in the end could even lead to some negative perception of the portal.

The statements by the participants on the integration of social media functionalities can also be counted as 'indifferent'. This again means that expanding the portal by such functions would be perceived neutrally at best or even negatively, possibly leading to a devaluation of the portal. As a result it seems not advisable to integrate these kinds of offers.

An interesting aspect can be found in some statements about the 'general presentation' of the portal. Some users asked for a functionality that allows using light

scattering simulation programs online. While the statements were given in the frame of a 'basic requirement' category with a 'must be' impact this should be counted as 'enthusiasm requirement' with impact on the 'attractiveness'. Therefore it seems to be reasonable to expand *ScattPort* by such a function.

Finally, the question asking users to give own suggestions for improving the *ScattPort* portal can be seen as ‘questionable’.

4 Evaluation by web analytics (Google Analytics)

The potential of user traffic analysis for usability evaluations of web portals was demonstrated by Hasan et al. [Hasan 2009]. Therefore the web traffic data for *ScattPort* between 14th Oct. 2010 and 18th Jan. 2011 was gathered via Google Analytics. This is the time span the questionnaire described above was online. The aim of this evaluation was to match the conclusions that could be collected from the web access with those collected from the questionnaire and to look for accordance as well as contradictions.

4.1 Access during the evaluation period

Within the evaluation period 5718 visitors were counted. An overview is given in [Tab. 5]. The overall traffic for the portal was consistently strong.

visits	5718 (58 per day)
specifiable visits	3931
page views	20127
average number of page views	3.52
average visit time	3:28 minutes
exit rate	56.12%

Table 5: Google Analytics web statistic (14/10/10 to 18/01/11).

During the period *ScattPort* was accessed from 93 countries. [Fig. 7] shows the top ten access countries. This result is not very surprising, as scientists from these countries also contribute to articles in scientific journals mostly.

The In-Page-Analysis gives an impression about the most popular topics presented on the site. The top five sections are listed in [Tab. 6]. This strongly supports the conclusion that the list of available light scattering software is regarded as the most important content by the users.

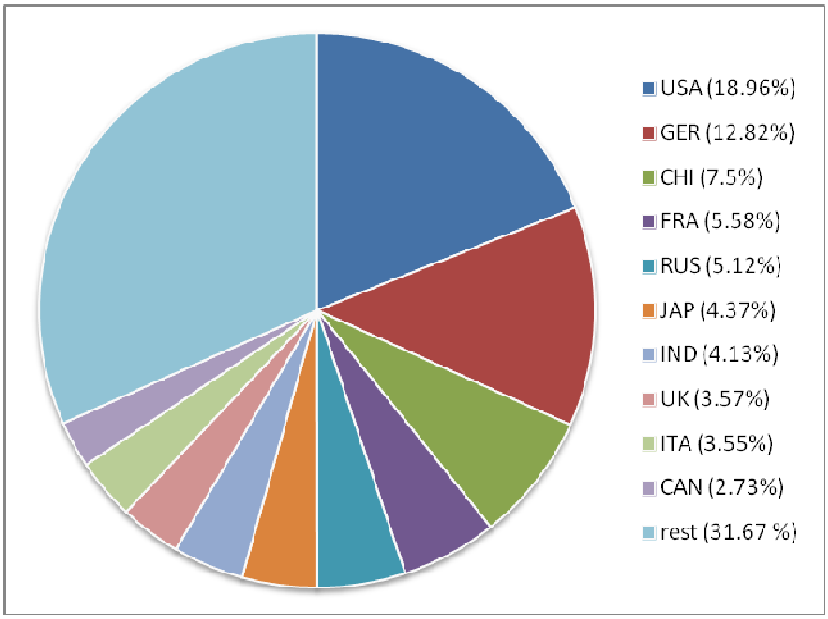

Figure 7: Access countries, top 10.

Programs	22.0%
Vacant positions	4.4%
Light scattering news	4.3%
Conferences	2.6%
Short articles	2.5%

Table 6: Top five accessed sections.

4.2 Traffic origins

One of the most important aspects for the analysis of the web traffic is the origin of the access: did the user start a search engine query, did he follow an external link to *ScattPort* or did he visit the portal directly, e.g. by a bookmark? This helps to understand the motivation of his visit. Direct hits and bookmarks imply that a user regards the offered information highly.

During the studied period 1288 direct visits and 1394 hits via external links were counted. [Fig. 8] gives an illustration.

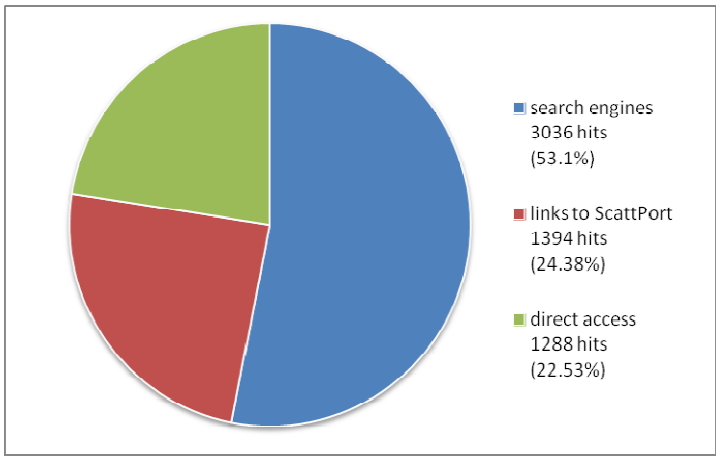

Figure 8: Google Analytics statistics of origins.

At this point it must be noted that until the launch of *ScattPort* in its current form a predecessor web page existed – *www.t-matrix.de* [Wriedt 08]. This URL is also widely listed in articles published before 2009. When *ScattPort* went online this old URL was redirected to *www.scattport.org*. This means: users, who access *ScattPort* via the old link, must be considered as regular, recurrent users. This is an indication for quality. It also means that theses accesses should be counted as 'direct' ones.

[Fig. 9] gives an overview of sites referring to *ScattPort*.

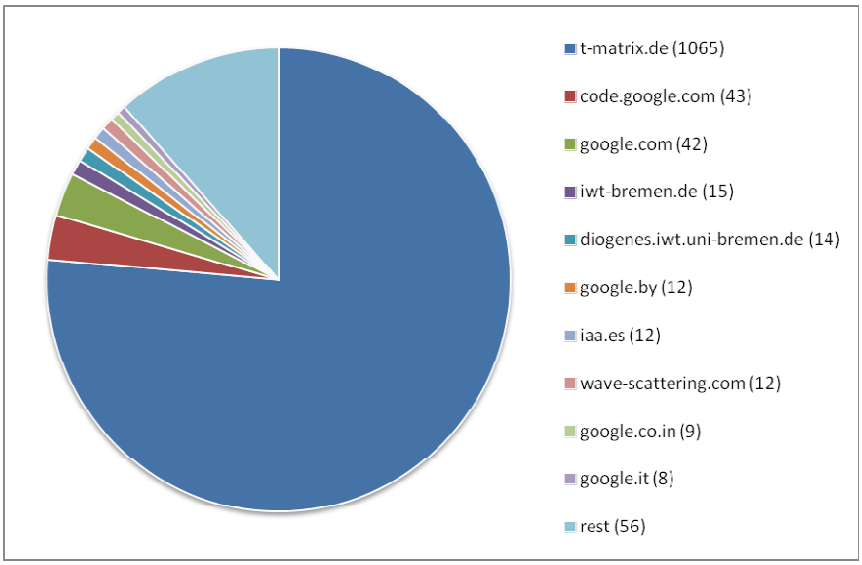

Figure 9: Access numbers (absolute values) via external links.

Of the 1394 hits originating from external links, 1065 (=76%) were from the predecessor URL *t-matrix.de*. The URLs *diogenes.iwt.uni-bremen.de* and *iwt-bremen.de* belong to the hosting institution of *ScattPort*. Requests from these computers are mostly routine visits, e.g. for maintenance reasons or content checks. Therefore they are 'internal visits'. As a result one can conclude that there are not many 'real direct external' referrers. For this reason for further consideration we will omit distinction between "referring sites" and "direct traffic".

This means, that about 47% of the access can be considered to be direct [see Fig. 8]. This is in accordance to the conclusions from the questionnaire and underscores the relevance of the portal content.

Comparing the overall access number (5718 visits) to that of visitors using the old URL from the predecessor web page (1065 hits = 19%) one can conclude that these users follow the offered information about light scattering regularly for many years. They could be called the 'loyal' users.

A closer look on the access rates of users entering the *ScattPort* portal via search engine queries shows, that a high number of them leaves the page after only a short time. This high exit rate combined with a negligible length of stay implies that these users were looking for some completely different content. They simply do not belong to the targeted user group.

5 Summary

This paper describes the analysis of a scientific internet information portal in regard to its content and potential value for users. Here, several aspects are of interest:

- applicability of established procedures of usability engineering,
- the adaption of these methods for the *ScattPort* internet portal, as these methods are usually aimed at commercial sites,
- results of the evaluation plus interpretation.

For the evaluation of the users' demands and expectations the method UEQ was applied, consisting of an established questionnaire plus additional questions to the users. Then this UEQ evaluation was compared to the analysis of the web traffic (Google Analytics). All three methods lead to consistent results, there are no obvious contradictions. Because of this one can deduce that:

- the conclusions are reliable and therefore allow a qualified analysis of *ScattPort*,
- the established method UEQ, usually applied to commercial internet pages, can also be used in general to evaluate non-commercial, scientific internet pages.

After this first general findings of the studies described in this article we would like to summarize some more specific results for the internet information portal *ScattPort* itself.

The evaluation of the UEQ shows that *ScattPort* in its present state gets a 'neutral-positive' grade by its users. There is no significant criticism, the overall impression is favourable.

The associated additional questions also support this; again there is no significant criticism. This means that the most important basic requirements of the users are fulfilled.

The questionnaire also enabled the participants to comment possible functionalities for the future. Suggested by the authors of this study were an integration of 'social media' and the creation of a 'Wiki' on the subject of light scattering. The analysis of the responses shows that most users deem social media functionalities not necessary or they even object them. On the other hand a Wiki would be regarded useful and welcome. But this encouraging statement is diminished by an obvious restraint of the users to contribute content themselves. Therefore an addition of Wiki functionality might backfire and in the end lead to a negative impression.

The answers given in the questionnaire also prove that the information the users are looking for is covered in a satisfactory manner. In particular, the list of scientific software for the calculation of light scattering gets good grades and is regarded as a central offer of the portal.

Additionally the users could write down suggestions how *ScattPort* could be improved further to increase the attractiveness of the portal. Here, several participants asked for the implementation of an interface to use light scattering programs online.

The evaluation of the access data via Google Analytics supports the data gathered from the questionnaire. It indicates that the information portal *ScattPort* in its current state fulfils the demands of the users. There is a good percentage of recurrently visiting users; some of them still use the URL of predecessor site *t-matrix.de*. This means they are ‘loyal’ visitors for many years which in turn demonstrates the quality of the content.

The web traffic data also provides information about the keywords users entered for search engine queries which then let them to *ScattPort*. This contains useful information for the operators of the portal and should be taken into account for further improvements in the future, e.g. by setting up appropriate landing pages.

It was found that the application of established methods for the evaluation of Usability and User Experience to scientific information portals as demonstrated in this paper proved to be reasonably successful. Nevertheless, it is still in an initial state. For an outlook we would like to apply our findings to other editorial internet information offers. Another promising field for studies might be the application of the outlined methods to different scientific branches, like the evaluation of dynamic internet content or data mining.

We invite our readers to contact us in case they have questions, would like to apply the outlined methods to own internet sites or to discuss further fields of applications. Any kind of feedback is welcome.

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