

Key Concerns for Website Quality: Reflecting on User Views

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Abstract — The study compares and contrasts attributes of user perceived quality with information websites. It concerns a study of the formation of website quality, its nature and evolution based on the fulfillment of typical tasks. Based on empirical study based on 44 information websites, information value and navigation have been identified as key ingredients perceived by website users when judging website quality. Color scheme assessment was found to predict successful task fulfillment.

Keywords—user view, satisfaction, website quality

I. INTRODUCTION

Consumer satisfaction and its determinants have become one of the most frequently and widely researched topics [3]. Consumer satisfaction shows various characteristics from which non-linearity and asymmetry have been assigned a prominent role. The consumer-product relationship seems similar to the link between a user and a website (e.g. [32]; [13]). Consumer satisfaction shows various characteristics from which non-linearity and asymmetry have been assigned a prominent role [16]. Therefore similar asymmetry and non-linearity of user satisfaction could be supposed for user satisfaction with websites (e.g. [27]; [18]; [9]). Non-linearity and asymmetry of user satisfaction with website have been previously investigated using mostly transaction and commercial websites. However, there are other types of websites (i.e. information, identity, education, community, and entertainment sites) and their end-user satisfaction can be formed by differing features and attributes.

Satisfaction with information-type websites is of prime importance as providing information used to be one of the original ideas, which gave the www its birth. It is even believed that the information role of websites has been lately increasing [11].

Information itself could be seen as a special product [32] with many specifics [23]. Information websites can be, hence, viewed and examined as products just as well, whereas their information quality is the key success factor [20]. It is expected that website quality assessment would be of dynamic nature,

i.e. websites could be assessed differently at the first sight and throughout the use of a particular site.

Quality means the ability of products to be used for their intended purpose [15]. Definitions of web usability read similar – a website reaches high quality levels and satisfies its users if it is sought for the intended purpose it was designed and visited for [4]. A website is a heterogeneous media; therefore usability parameters may vary according to the website purpose (for meta-analysis of the topic see e.g. [25]).

Automatic or machine-based measurement of website usability is generally impossible. Usability can be measured by experts or end-users[21]. Both expert and end-user testing are rather complementary than mutually exclusive: expert testing is usually less costly and can uncover many usability issues [22]. The complete account on usability can hardly be acquired without end-user testing [6]. User views and experiences can be best researched through scenarios and assigned model tasks [24]. Such scenarios must reflect the intended purpose of a website and its target users [31].

II. METHODOLOGY

The research study presented here was based on two step website quality assessment, one conducted before any direct user experience with the website and one after a user has performed various model tasks. At the beginning, respondents were shown a website for five seconds ([17]; demonstrated that key website attributes are recognized by a user within first 50 milliseconds – our research allowed one hundred times the minimum suggested viewing time). The goal was to measure user views without direct experience with the website. Afterwards, the respondents expressed their agreement on six statements.

Tested criteria addressed several usability and quality issues and focused on areas: color scheme, visual appeal navigation, layout, navigation, content and overall impression.

The following user experience was based on accomplishing specific tasks (information retrieval). Success of each of the information activity was measured based on correct (open-ended) answer to the task. There was not an instant feedback to

participants whether they were successful in completing the task or not. It was left up to them to judge whether they succeeded. After the tasks, respondents expressed their level of agreement on the same six statements as in the beginning of the survey. The aim was to establish whether and how the perception shifted in relation to success or failure in fulfilling the assigned task.

The research has been undertaken in accordance with the scheme shown in Fig. 1.

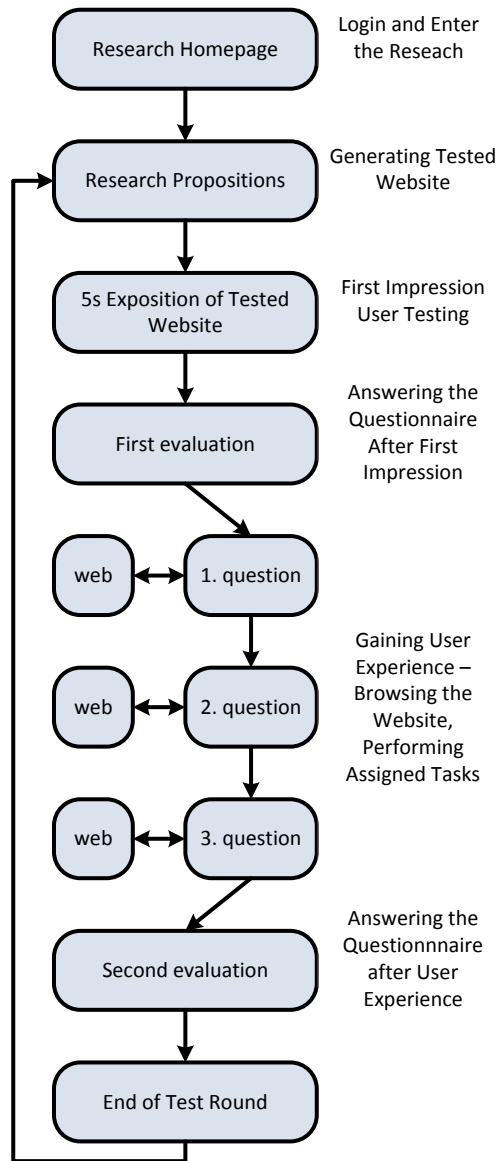


Figure 1. The Research Scheme

In order to best reflect on the specific needs of end-users, this research was designed to uncover specific website quality attributes perceived by a specific target group. The sample consisted of 44 distinct primarily information websites of Czech business schools. Business school websites are publicly accessible and are aimed at various user groups. One of the key criteria for website assessment is that the evaluation should be

undertaken only by the users, which are targeted by the web designers and website owners ([5]; [20]; [31]). The various users of business school websites can be distinguished between prospective, current and former students, academic and non-academic staff, industry specialists, the general public and prospective, current and former partners such as benefactors, investors and public authorities. Those groups would perhaps vary in their needs and the type of information they seek. In the case of universities, the group with the most generated website traffic is the current students. Therefore, the respondents in the research here were the students of one business school in the Czech Republic and 30 respondents participated in the study. Each respondent evaluated each of the 44 business school websites in the Czech Republic (other than their alma mater). The participants assessed websites in a random order generated by computer. Websites were also displayed to participants in a random order – this prevented respondents from gaining the same experience throughout the study, which may otherwise cause variation in their satisfaction [14].

III. RESULTS

Users were optimistic when approaching a website – having a generally positive and open mind and expecting good website performance. As they work on typical tasks and spend some time with the site, their views usually change for worse. Most attributes demonstrated an insignificant increase in user satisfaction when users succeeded in the task, while low web performance (task not fulfilled) resulted in a significant drop in user satisfaction. The asymmetric and non-linear character of user satisfaction has been confirmed on 95% confidence level. The curve for user satisfaction could be constructed as it is seen on Fig. 2.

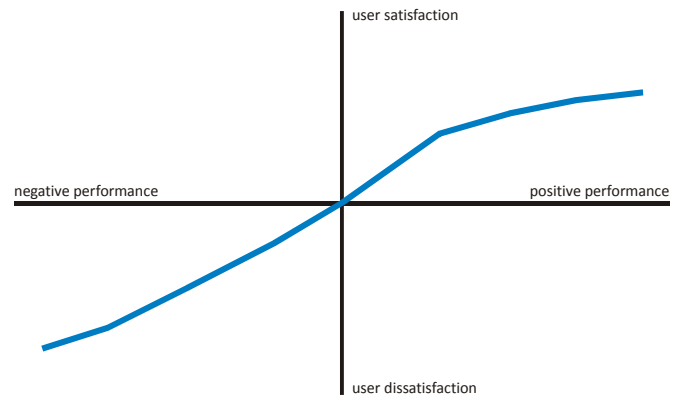


Figure 2. Asymmetric effect of user satisfaction with information websites

The effect of positively perceived performance on user satisfaction is only 0.75, compared to (equal) negatively perceived performance on user dissatisfaction. The curve could be estimated as follows (model fits survey data at 93% level):

$$\text{User_satisfaction} = -2,967 \text{ prod_perform}^3 - 5,776 \text{ prod_perform}^2 - 342,174 \text{ prod_perform} \quad (1)$$

Subsequent analysis was employed to determine the most influential website quality attribute. Classification methods of data mining can be used to decide, if certain levels of expressed

user satisfaction (measured AFTER the experience with website) could assume the result of user activities (YES for successful, NO for unsuccessful). All respondent evaluations were re-coded to a three-point ordinal scale (1 and 2 = GOOD, 3 = NEUTRAL, 4 and 5 = BAD) from the original five point scale. The J48 classifier based on C4.5 algorithm (Quinlan, 1996) provided the results shown in Fig. 3.

The numbers in the nodes represent the ratio of classified units in the branch and the ratio of incorrectly classified units in the node. The tree presented above correctly classifies 71 % cases. This further confirms the prominent role of content and ascribes the second part to website navigation.

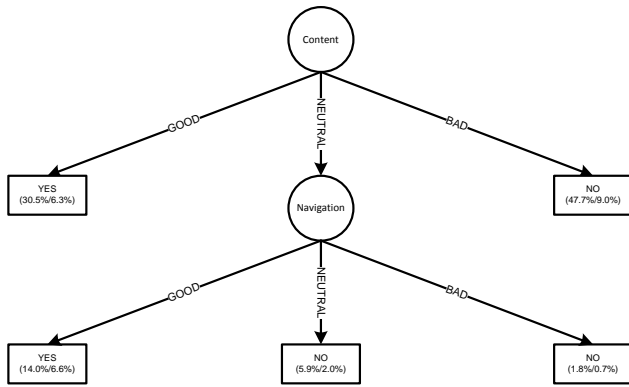


Figure 3. Pruned tree for website attributes (AFTER user experience)

Hence, user-based testing could be based on those two attributes only and yet it would depict the overall satisfaction. It remains a question whether users are able to assess various website attributes at the first look quite to the same degree as opposed to the situation, in which they have or have not succeeded in searching for particular information. To answer that question, another decision tree was constructed. It helps to establish, whether certain levels of expressed user satisfaction (now measured BEFORE the experience with website) could presume the result of upcoming user activity.

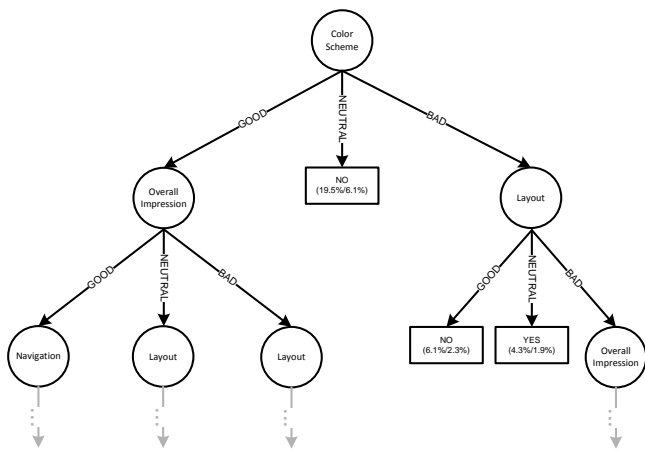


Figure 4. Figure 4: Pruned tree for website attributes (BEFORE user experience)

The resulting pruned tree is more complex and less reliable (53 %) in determining user satisfaction decisions. It indicates that there might be a connection between assessing color scheme prior to the activity and the actual outcome of such an activity. More thorough analysis of the relationship between the assessment before and after the activity was conducted using chi-square statistical test for categorical data in two unpaired groups [1]. Results are as show in Table 1.

The results indicate that there was not a statistically significant difference between assessing each component before and after the activity except for color scheme. Color scheme was rated differently for successful and unsuccessful user experience (p-value 0.011). Judging first impression of website colors proved to be a solid predictor of further user experience – it may be of interest for future research to learn what the impact of colors on information websites might be. Users who do not like website colors may perhaps find it more difficult to browse through the site and seek the information they want.

TABLE I. CHI-SQUARE TEST RESULTS

	Color Scheme	Navigation	Layout	Visual appeal	Content	Overall impression
Std. MH Statistic	12.984	4.517	4.033	4.588	1.732	7.242
p-value (2-sided)	0.011	0.341	0.402	0.332	0.785	0.124

Furthermore, other website attributes assessed in our study are more comprehensive and could be judged with lesser ease at first sight. During the initial short website exposure (5 seconds in this study), a user has enough time to consider “trivial” attributes [17] such as the color scheme, while other component such as navigation may need more time to be properly evaluated. Colors appeal to human sub-consciousness. Technically speaking, colors also appear on website before its contents is uploaded. Moreover, colors may impact the overall website perception. Assessment of overall website attractiveness was different for websites which did and did not succeed in a typical task. Although the p-value (0.124) is slightly above the conventional statistical level, it is material considering the exploratory nature of survey.

Could the prominent role of color scheme be attributed to certain colors or color combinations? For color interactions, usability guidelines [25] recommend specific contrast levels between front and background colors. Contrast levels can be calculated based on WCAG formula (guidelines available at www.w3.org/TR/WCAG20). Table 2 presents website ranking based on color computations suggested by WCAG 1 and 2.

TABLE II. WEBSITE RANKING ON COLOR SCHEME

Web	WCAG 2.0		WCAG 1.0			
	Text/ Bgrnd	Navig/ Bgrnd	Text/ Bgrnd		Navig/ Bgrnd	
			Color Diff	Brightness Diff	Color Diff	Brightness Diff
26	11	21	185	195	765	255
44	14,2	14,2	607	210	607	210
20	7,1	4,3	502	167	421	153

Web	WCAG 2.0		WCAG 1.0			
	Text/ Bgrnd	Navig/ Bgrnd	Text/ Bgrnd		Navig/ Bgrnd	
			Color Diff	Brightne ss Diff	Color Diff	Brightne ss Diff
13	17,8	5	693	231	405	107
4	10,5	7,8	576	192	526	181
10	13,8	21	625	207	765	255
29	17	15,3	693	231	592	216
2	21	7,8	765	255	528	192
41	18,5	14,1	704	230	615	216
31	6,9	4,5	495	165	361	132
25	21	2,5	765	255	356	118
30	21	3,5	765	255	432	138
37	16,3	2	627	225	220	75
39	9,3	3,1	420	161	403	124
23	3,5	4,1	549	181	491	149
17	17,7	8,3	727	246	540	184
22	18,4	6,1	720	240	415	164
3	21	5,3	765	255	444	148
18	21	18,5	765	255	703	239
15	14,5	11,1	642	214	537	189
6	16	16	675	224	675	224
32	16,6	2,9	765	255	342	105
33	21	5,6	765	255	467	160
24	21	2,5	765	255	356	118
28	10,8	6,5	558	186	483	161
38	21	7,6	765	255	444	172
1	19,4	13,4	740	125	617	204
7	17,9	17,9	670	235	670	235
42	7,7	9	516	172	528	176
8	19,1	6	732	244	461	160
27	14,5	15	765	255	604	219
5	21	10,8	765	225	558	184
16	19,6	4,2	733	246	408	131
35	13,8	12,2	624	208	582	194
43	5,8	5,3	405	172	520	142
36	16,2	14,1	678	226	588	216
34	21	17,7	765	255	718	237
11	21	7,8	765	255	385	140
12	15,2	7,9	625	215	554	173
19	21	8,7	765	255	531	188
9	21	4	765	255	510	179
21	21	19,3	765	255	735	245
40	15,3	4,6	660	220	371	119
14	13,7	8	626	202	442	162

Cells highlighted in Table 2 put forward those websites which do not attain sufficient contrast levels. If user views would depend on the contrast levels, the highlighted cells would have to be grouped low in the table. However, websites with most insufficient contrast levels (23, 31, and 43 based on WCAG 2; 26, 31, 39, and 43 based on WCAG 1) were rated on color scheme reasonably well by users (web 23 - 23 - 13; web 31 - 14; web 26 - 9; web 39 - 26).

A similar conclusion can be made based on Table 3 which presents the ranking based on user-assessment and on WCAG 1 and 2 guidelines.

TABLE III. WEBSITE RANKING ON COLOR SCHEME BASED ON WCAG 1 AND 2 METHODOLOGY

web	Evaluation BEFORE	Evaluation AFTER	WCAG 2.0 Text/ Bgrnd	WCAG 2.0 Text+Nav/ Bgrnd	WCAG 1.0 Text/ Bgrnd	WCAG 1.0 Text+Nav/ Bgrnd
1	20	27	16	8	38	25
2	3	8	1	17	1	10
3	27	18	2	26	2	23

web	Evaluation BEFORE	Evaluation AFTER	WCAG 2.0 Text/ Bgrnd	WCAG 2.0 Text+Nav/ Bgrnd	WCAG 1.0 Text/ Bgrnd	WCAG 1.0 Text+Nav/ Bgrnd
4	4	5	38	31	35	27
5	32	32	3	12	20	15
6	29	21	27	9	26	7
7	25	28	20	4	24	6
8	23	30	17	24	18	21
9	44	41	4	29	3	13
10	5	6	33	5	32	5
11	30	38	5	18	4	28
12	36	39	29	22	30	22
13	8	4	21	28	22	38
14	42	44	35	27	34	30
15	19	20	30	19	29	20
16	21	33	15	30	16	29
17	31	16	22	21	17	14
18	33	19	6	2	5	3
19	43	40	7	15	6	11
20	15	3	41	42	40	40
21	37	42	8	1	7	1
22	7	17	19	25	19	24
23	13	15	44	44	37	35
24	22	24	9	36	8	32
25	24	11	10	37	9	33
26	9	1	36	10	44	36
27	34	31	31	13	10	4
28	12	25	37	34	36	34
29	10	7	23	7	23	9
30	11	12	11	32	11	26
31	14	10	42	40	41	42
32	41	22	24	38	12	37
33	16	23	12	23	13	19
34	35	37	13	3	14	2
35	28	34	34	16	31	18
36	40	36	26	11	25	12
37	2	13	25	39	28	44
38	17	26	14	20	15	17
39	26	14	39	43	43	43
40	38	43	28	33	27	39
41	6	9	18	6	21	8
42	18	29	40	35	39	31
43	39	35	43	41	42	41
44	1	2	32	14	33	16

In case users will regard highly websites with good readability and high contrast, both rankings would be the same. The measure of rankings proximity is the Spearman Rho correlation coefficient, which was employed in order to test the assumption. Resulting calculations are presented in Table 4.

TABLE IV. RANKING CORRESPONDENCE BETWEEN USER EVALUATION AND WCAG GUIDELINES

		WCAG 2.0 Text/ Bgrnd	WCAG 2.0 Text+Nav/ Bgrnd	WCAG 1.0 Text/ Bgrnd	WCAG 1.0 Text+Nav/ Bgrnd
Evaluation BEFORE	Spearman koef	-0.197	-0.084	-0.283	-0.176
	Sig. (2-sided)	0.200	0.590	0.063	0.252
Evaluation AFTER	Spearman koef	-0.228	-0.123	-0.246	-0.195
	Sig. (2-sided)	0.137	0.426	0.107	0.206

The first row shows the Spearman coefficient between user evaluation and computations based on suggestions of WCAG

guidelines. The second row presents the outcome for 2-sided hypothesis testing for correspondence of both rankings. The results indicate that in both cases – for initial and subsequent user assessment – our hypotheses can be rejected on 95% confidence level. With 90% confidence, user-based initial assessment corresponds to WCAG 1.0 for text and background colors.

Seeking for alternative explanations, a closer look at top 10 highest ranking websites may offer certain hindsight:

- 9 websites have blue as their dominant color (1 has wine). Blue is considered the color of trust, conservativeness, and education alike. Wine color is perceived similarly [7].
- 10 websites use their primer color in a dominant graphic feature (usually a stripe with motive or logo in upper part of the website). The dominant color sets the tone for the entire page.
- All top 10 websites have dark-toned dominant graphic feature in upper part of the site, whereas regular text is printed in dark letters on light-colored background (typically white or light gray). Such combination is deemed more readable than the opposite [10]; [26].
- 7 websites open their internet presentation with eye-catching professional pictures and photos from campus life. First impression is formed not only through foreground and background colors but evoked by pictures and their coloring.

In contrast, for 10 least favorably rated websites:

- 7 websites have no dominant graphic feature. First impression is based primarily on text and text formatting.
- 7 websites appear outdated in terms of webdesign or software technologies such as table layout, frames, and inappropriate use of forms.
- 7 websites contain minor graphic element which is apparently home-made, unprofessional or outright inappropriate such as unadjusted photos or poor graphics.
- 5 websites use darker colors for background although text is still printed in even darker shades, which makes the text less readable and thicker.

Apart from contrast, emotions and feelings triggered by combinations of colors, signs and pictures might be important. Users pay more attention to aesthetics, than to contrast or readability [27]. Hence, simple calculations of contrast may not be a good proxy for assessing user satisfaction with color scheme.

IV. DISCUSSION AND CONCLUSION

It was confirmed that user satisfaction with websites is non-linear and asymmetric which is in alignment with previous findings about other products and services. The degree of asymmetry (as a ratio of consumer satisfaction with good

website performance to the degree of consumer dissatisfaction with poor website performance) was calculated at 0.75 indicating that positive satisfaction manifests itself to a lesser degree than a negative one. However, all surveyed attributes do not play equal role in that asymmetry.

Color scheme assessment does not contribute to the asymmetry. Satisfaction with website navigation decreased when users did not succeed in fulfilling the task and increased when they did attain their goal. Other attributes (layout, visual appeal, content, overall impression) followed the typical path – when users were not able to perform the task well, their satisfaction scores lowered; when users did perform well, their satisfaction levels remained unchanged.

Further analyses uncovered that certain attributes are more sensitive to website performance delivery. Satisfaction with information value and website navigation differs significantly based on the outcome of typical user activity. Hence, their assessment based on first impression only might be inappropriate if not oblivious. Future research studies or practitioners' assessment metrics may be possibly limited only to these two items (e.g. [2]; [34]) as they would still reflect more than 70 % of the overall quality-satisfaction.

First impression of colors and color scheme perception was, in contrast to information value and navigation, able to predict results of subsequent user activities – users who did not like the colors at the first sight did generally not succeed in a typical task and vice versa. User comfort and satisfaction may be deeply embedded in aesthetic appeal. "Beautiful" websites may bring higher level of user satisfaction [29]. A successful information website should, therefore, present information in a visually attractive and appealing way. Usability recommendations for color contrast [25] were empirically tested and it was found that users did not necessarily reflect on WCAG guidelines. Perception of colors may encompass other attributes such as psychological, emotional or subconscious.

Although the findings offer many supportive conclusions, they should be accepted with caution. The study examined only information websites and one particular target group. Other types of websites [12] may produce different outcomes in regard to user satisfaction and its asymmetry and/or may identify different items to be relevant for user-based evaluation. Further limitations can be related to the sample size and other sample characteristics, such as the geographical and cultural location of the Czech Republic, although user-based testing should only address target users [18]; [5]; [20] and hence it reflects on embedded cultural and demographic characteristics [30]; [8]; [33].

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