University of Bari's Website Evaluation

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Abstract Educational websites were studied from many different perspectives. In 2001, Zhang and von Dran developed a theoretical framework for evaluating website quality from a user satisfaction perspective, while Yoo and Jin in 2004 evaluated the design of university websites. In this paper, we assess the quality perceived by the users of the website of the University of Bari using factorial analysis and multiple correspondences analysis (MCA) visual maps. Latent variables resulting from this preliminary analysis were then used to evaluate the most important latent dimensions related to loyalty of the users. A segmentation analysis was performed to study how loyalty is influenced by variables and factors.

Keywords Customer satisfaction · University website · CATPCA · Factorial analysis · MCA · Classification tree

1 Framework and Survey's Description

The university websites are the most important information channel, in fact they provide general information, facilitate contacts between teachers and students, etc. Quality and usability of the websites are, therefore, very important to improve student satisfaction.

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This work aims to evaluate the user satisfaction of the website http://www.uniba.it, using a ten-section CAWI questionnaire: *User profile*, *Graphics of the website*, *Website contents*, *Services*, *Error Handling*, *Website management*, *Interruptions management*, *Usability*, *Security/privacy* and, finally, *Overall Satisfaction*. The first nine sections contain several items, measured with a four- or five-level scale.

2 Explorative Analysis

Table 1 reports the average scores given by the 1,049 respondents to the main aspects considered, according to the frequency of access to the website. This frequency has an important role because it allows to distinguish occasional users from expert ones.

21.9% of respondents access the website only in few occasions, but 10.7% declare that they browse the website several times a day. 67.4% of respondents visit the website one to several times a week. In most cases students are quite satisfied, the average mark ranges from 3 to 4 in a five-point scale, and there are not great differences between occasional users and expert ones, but expert users are a little more satisfied than the others.

An exception concerns, obviously, the item "reporting of errors/malfunctions during browsing", because frequent users are presumably annoyed by errors/malfunctions more often than occasional users.

3 Identification of the Website Quality's Dimensions

The Bartlett's test of sphericity for the observed 46 items was very significant (p-value < 0.0000001), allowing the use of principal component analysis (PCA) to explore the dimensions of website's quality.

Because some observed variables are measured on few level categories and not normally distributed, the ALSOS CATPCA was applied instead of PCA .[1] By using a backward stepwise procedure, only factors with eigenvalues higher than 1.1 were selected, iteratively removing all items with communality lower than 0.51. As final result, we obtained a correlation matrix with 25 optimally scaled items, identifying six principal components that explain 70.2% of the overall variance.

[1]The CATPCA (categorical principal component analysis) algorithm is due to the Data Theory Scaling System Group of the Leiden University, NL (De Leeuw et al. 1976; Meulman et al. 2004). It belongs to the PRINCALS family, based on *Alternative Least Squares Optimal Scaling* procedures, allowing researcher to use categorical variables, while PCA requires at least interval-scaled variables and normal distribution of residuals. Incidentally, also classic PCA was performed in explorative way, providing almost the same results than CATPCA.

Table 1 Average rate of significant items, according to the user's frequency of access to the website of the University of Bari Aldo Moro; percentages of users access frequency

Statistically significant items* ($p < 0.001$)	Frequency of access				*All users*
	Never/at times	About once a week	Several times a week	Several times a day	
Utility level of the published information	3.36	3.55	3.71	3.64	*3.57*
Level of depth and detail of the content	3.07	3.15	3.22	3.32	*3.17*
Comprehensibility of the used lexicon	3.85	3.94	4.03	3.87	*3.94*
Reporting of errors/malfunctions during browsing	3.38	3.23	2.99	2.93	*3.16*
Duration of the service interruptions	3.05	3.06	3.10	3.09	*3.07*
Download time	3.65	3.78	3.91	3.85	*3.80*
Viewing the site on any browser	3.63	3.71	3.87	3.76	*3.75*
Appropriateness of the content discussion	3.42	3.64	3.49	3.62	*3.55*
Comprehensible and unambiguous terminology	3.39	3.57	3.63	3.67	*3.56*
User recognition	3.82	4.01	4.10	4.08	4.00
Overall assessment about the website	**3.42**	**3.51**	**3.48**	**3.71**	**3.50**
% by access frequency	21.9	37.2	30.2	10.7	100.0

*Statistics significances were obtained by using the test of maximum likelihood ratio ($\alpha = 0.05$)

The Kaiser-Meyer-Olkin value is very high (0.92), ensuring excellent fitting of the model to data.

Starting from the identified principal components, a factor analysis (Cattell 1952) was conducted by using non-orthogonal promax rotation, in order to obtain a simpler solution. The promax rotation allowed to identify the most characterizing variables for each latent dimension, preserving relationships between the factors (Manly 1986).

Table 2 shows the residual correlations not due to direct relationships among the observed items. Only the first four factors have high correlation coefficients showing a *structural relation* among factors.

In Table 3, the *communalities* column indicates the variability explained by the factorial system, or in other words, the importance of the observed item. The factor loadings express the intensity of the relationship between variables and factors.

Table 2 Correlation among factors in the promax solution*

Factors	F1	F2	F3	F3	F4	F5
F1	1	**0.480**	**0.628**	**0.434**	*0.270*	**0.397**
F2		1	**0.553**	**0.474**	0.089	*0.282*
F3			1	**0.496**	*0.187*	**0.343**
F4				1	0.084	*0.183*
F5					1	*0.104*
F6						1

*Statistical significance = Bold font: $p < 0.01$; Italic font: $p < 0.05$

Table 3 Factor loadings and communalities of the items of the promax rotated solution*

Items	Factors						*Communalities*
	F1	F2	F3	F4	F5	F6	
Clarity of the site map	0.949						*0.793*
Information's accessibility in a few clicks	0.918						*0.785*
Map accessibility	0.857						*0.696*
Categories classification while browsing	0.822						*0.705*
Understandable terminology	0.683						*0.555*
Useful information on the site	0.521		0.350				*0.604*
Services/activities simplification	0.482		0.366				*0.571*
Opening speed of the pages		0.910					*0.839*
Website load speed		0.908					*0.815*
Download speed		0.879					*0.776*
Scrolling speed		0.836					*0.758*
Viewing the site on every browser		0.827					*0.705*
Comprehensibility of the used lexicon			0.868				*0.699*
Utility of the published information			0.849				*0.703*
Clarity of the contents			0.809				*0.730*
Level of depth and detail of the content			0.795				*0.713*
Adequacy of the contrast between font and background colour				0.855			*0.776*
Font size				0.808			*0.733*

(continued)

Table 3 (continued)

Items	Factors						*Communalities*
	F1	F2	F3	F4	F5	F6	
Visibility of the website features				0.712			*0.556*
Language selection					0.890		*0.760*
Responsiveness/alerts of technical inefficiency in the contact form					0.789		*0.633*
Accuracy/correctness of the translation					0.648		*0.606*
Error messages/corrective action						0.891	*0.811*
Alerts of errors or malfunctions						0.785	*0.640*
Error/data recovery						0.659	*0.593*

*Factor loadings lower than 0.33 have been omitted in this table

By evaluating such relationships, the factors can be then interpreted as follows:

- Factor 1: Accessibility and usability;
- Factor 2: Access speed;
- Factor 3: Information and content;
- Factor 4: Graphics and readability;
- Factor 5: Interactions;
- Factor 6: Error handling.

4 Proximity Map of the Observed Items

In order to confirm factorial similarities and to identify the main relationship, a visual map was used. Figure 1 shows the first two dimensions resulting from the multiple correspondence analysis obtained using the ALSOS algorithm: HOMALS (De Leeuw and Van Rijckevorsel 1980).

The position of the 25 centres of gravity of the observed variables highlights the relationships among the factors to which these variables are related (de Leeuw 1984; Gifi 1990). The points related to each factor are inserted in a shape with the corresponding number of the factor.

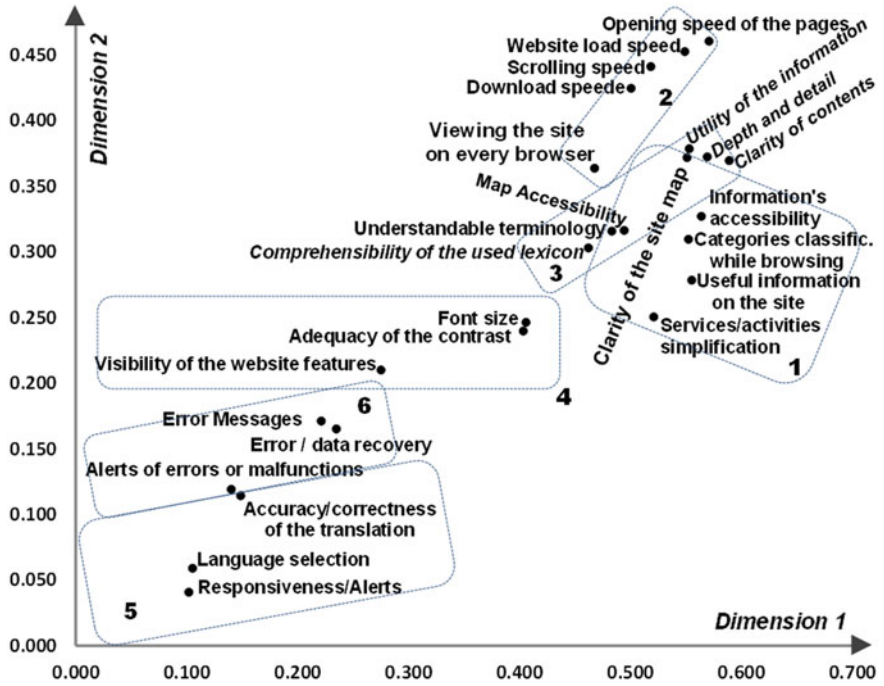

Fig. 1 Multiple correspondences map of observed items (first two dimensions)

The first two dimensions of MCA explain more than 70% of the total inertia. Figure 1 shows that the results of the factorial analysis are quite congruent with the two dimensions of the MCA.

The centres of gravity are concentrated along the main diagonal, ranking variables, and factors according to their importance with respect to the unidimensional concept of quality. The lower end of the diagonal (the less important items) is identified by the variables corresponding to factor "interactions", while the factor "access speed" identifies its upper end, i.e. the most important variables.

5 Quality Dimensions and Loyalty Elements

Loyalty can be predicted through classification methods. After many attempts, we choose to try a classification tree using the binary variable "access frequency" as response, where *high frequency* grouped the answers "several times a week" and "several times a day", while *low frequency* was associated with the other answers.

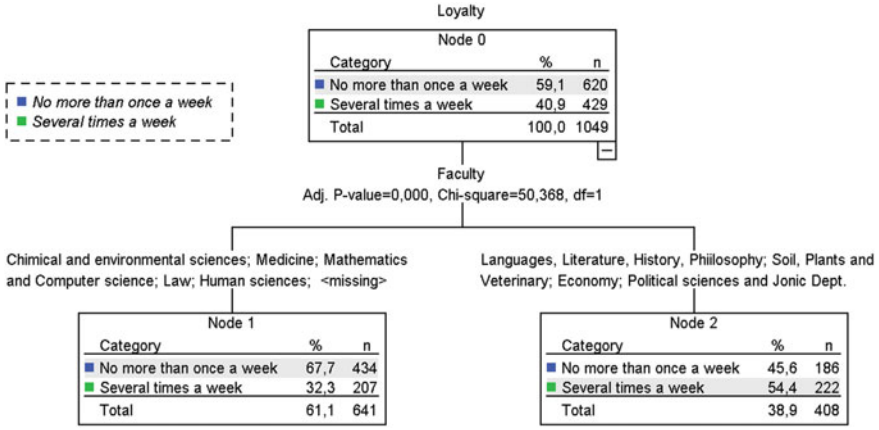

Fig. 2 Classification tree to predict the frequent access to the UNIBA website

All the interviewees characteristics (gender, residence, faculty, etc.) were selected as predictive variables, as well as the six quality factors identified above.[2]

The best known classification methods, CRT (Breiman et al. 1984) and CHAID (Kass 1980), were used, fixing 30 cases as minimum frequency of child nodes, expanded on maximum five levels of classification, and assessed by using cross-validation with 25 subsamples.

The chosen model, performed by using CHAID, can correctly predict the 62.5% of cases according the Faculty/Department (Fig. 2). The classification tree points out that students attending humanistic courses use the website more often than their colleagues of scientific courses.

The quality factors (precisely, "access speed", "information and content", and "interactions") appear at the second and third level of the classification tree, but without any effect on the predictive power of the model and thus they were removed by manual pruning.

The outcomes for the two cases "not more than once a week" and "several times a week" are quite different (see Table 4), because the latter response seems to be more difficult to identify.

The results here obtained are very good and robust, given that crossvalidation provides exactly the same risk values than the main classification (Table 5).

[2]The user's evaluation of the website could influence the frequency of access, because satisfied users tend (*cæteris paribus*) to browse the site more often than unsatisfied ones.

Table 4 Confusion matrix (classification table)

Observed website access frequency	Predicted website access frequency		
	Not more than once a week	Several times a week	Correct classification (%)
Not more than once a week	434	186	***70.0***
Several times a week	207	222	***51.7***
Total (%)	*61.1*	*38.9*	***62.5***

Table 5 Risk table

Method	Risk estimate	Std. error
Resubstitution	0.375	0.015
Crossvalidation	0.375	0.015

6 Concluding Considerations

This study showed a hierarchy of the variables, connected to the six dimensions of quality. Among them, the technical dimensions ("accessibility and usability" and "access speed") seem to be the most important, while the main mission of a website (providing *information and content*) has only the third position.

These findings were used, in addiction to the interviewees' characteristics, to analyse variables with respect to the loyalty proxy "access frequency to the website", by using segmentation analysis. Only a strong Faculty/Department effect was found, and this appears logical because, as it is known, the services are usually provided by these institutions following rules fixed at central level.

The main conclusion of this study is that the website quality has a weak influence on the "users loyalty", despite the current opinion "the higher the quality, the higher the loyalty".

Certainly, the analysis of the websites quality can not be limited to the few aspects described in the previous pages. This study should be considered just a first approach to the problem. Further analyses can start by the structural relationships here found among the quality dimensions, in order to find a causal model able to better explain the user behaviour.

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