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Development of a Numerical Index to Assess the Quality of Websites Design

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Abstract

A Website Design Quality Index, called WDQI, was developed to assess the websites design quality using a numerical approach. WDQI was formulated using a set of criteria such as availability literature on website design quality, previous reports, and the experts' opinions. Ten elements of websites design were included in the index: capacity and diversity of information, information modification and update, interactivity, reliability, usability, use of valid links and hyperlinks, clarity/simplicity, use of multimedia, navigation and its tools and loading speed. WDQI was applied to assess the design quality of three selected websites. WDQI has provided reasonable results in comparison to the actual state of the selected websites. Moreover, this index can provide valuable information for designers and engineers to obtain the high-quality design for websites.

Keywords

Interactivity; Website assessment; Website quality

Introduction

In the last decade, the use of the internet becomes an important commercial channel through the development of websites (Flavian et al., 2009). A very specific measure of the websites number on the World Wide Web is not available. However, Nielsen (2000) predicts a growth to 50 billion pages by 2005, and this number is expected to increase. Furthermore, the website is a very

important area of study which represents the primary user interface for net-enabled business, information provision, and promotional activities (Alba et al., 1997; Jarvenpaa & Todd, 1997; Schubert & Selz, 1998; Palmer, 2001). Therefore, the development of design criteria for websites has become an important necessity for continuous improvements in order to be suitable for use and meet the user needs.

Designers and managers are seeking to identify the elements of successful websites and explore a systematic method to assess the website design quality. Numerous studies were carried out to identify the most important elements that control the website success (Schubert & Selz, 1998; Palmer, 2001; Petre et al., 2006; Garett et al., 2016; Gao & Li 2018). Researchers have proposed different elements for websites usability and design in order to aid the designers.

Preece et al. (1994) defined website usability as "a measure of the ease with which a system can be learned or used, its safety, effectiveness and efficiency, and the attitude of its users towards it". One of the most commonly used measures is to track the Web visit and however, it failed to provide adequate insight into the ultimate success of a website (Picarille, 1997; Palmer, 2002). Based on previous reports, various elements were identified regarding the design of websites such as organization, graphical representation, consistency of the interface, response time, valid links, interactivity and so more (Palmer, 2001; Garett et al., 2016). Moreover, the international organization for standardization (ISO) does not specify precise standards for effective website usability and design. ISO has discussed usability in Software through 2 standards: (i) ISO 9241-11 which include “Guidelines on Usability". It defines usability in terms of effectiveness, efficiency, and satisfaction, (ii) ISO 9126-1 which include "Quality Model". It is concerned primarily with the definition of quality characteristics to be used in the evaluation of software products. It sets out six quality characteristics, which are intended to be exhaustive. These are: Functionality, Reliability, Usability, Efficiency, Maintainability and Portability (ISO 9126, 2002; Lee & Kozar, 2012). However; these standards have focused more on software. They need some extension and modification (Al-Badi et al., 2012).

Schubert and Selz (1998) developed a Web assessment model to evaluate the successfulness of Electronic Commerce Applications. Their model was based on four phases/modules: information, agreement, settlement and communication. Each module includes a set of criteria such as hypermedia presentation, time (availability and contact possibilities), ubiquity (availability and system performance), expert systems (personalization, possible product combination, configuration), and interactivity. Palmer (2002) has developed a website usability and design metrics based on a series of three studies. The data of this study was collected from corporate websites using three methods. He employed a multivariate statistical method such as factor analysis as a tool and found that the website success is associated with five elements, namely, website download delay, navigation, content, interactivity, and responsiveness.

Al-Badi et al. (2012) have studied the available literature on websites usability and their tools and guidelines. They concluded that the designers and engineers need a framework to help them assess the website usability (website quality). The present research attempts to propose a website Design Quality Index (WDQI) to evaluate the website's design quality using a new and simple approach. The proposed WDQI can be defined as the process of transforming the elements (responsible for a website's success) into a single number (a single value), and this number represents the overall description of the website design quality. WDQI has a scale from 25 to 100, the highest value represents better website design quality and lowest value indicates the poorest website design quality.

The idea of the present research has come from the water quality index (WQI) subject. Horton (1965) has developed a first numerical water quality index model in 1965 based on eight water quality parameters or indicators. He tried to transform these parameters such as pH, alkalinity, total dissolved solids (TDS), dissolved oxygen (DO), etc., into a single value that represents the overall water quality of the studied system (river, lake and estuary). Thereafter, a lot of water quality indices (WQIs) have been developed over the world by different institutions and authors (CCME, 2001; Cude, 2001; Sargaonkar & Deshpande, 2003; Boyacioglu, 2007).

Materials and Methods

The methodology of the present research can be summarized in five steps to assess the quality of websites design (Figure 1):

1. Identification of the general elements/features of the website's success
2. Transform these elements into a dimensionless number using a gradient appraisal scale
3. Assignment of weight for each element (Establishing weights)
4. Aggregation of the values (numbers) obtained in the previous steps to get the final value of the index.
5. Comparing the final value of the index on a rating scale limited between 25 -100.

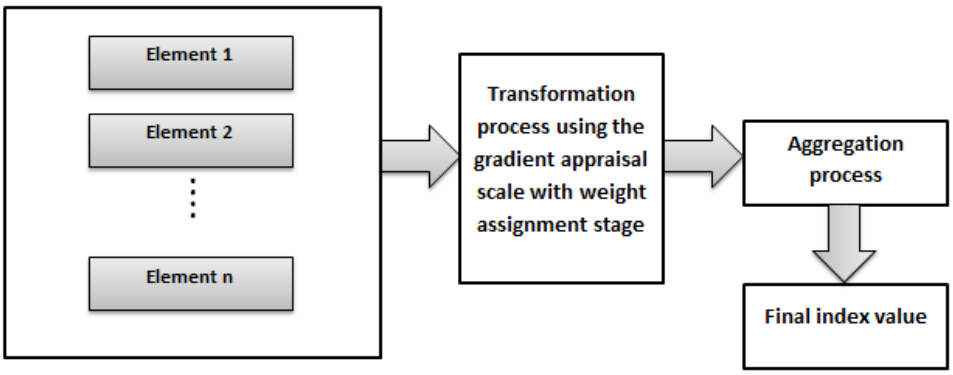

Figure 1. Structure of the WDQI

Results

Identification of the general elements/features of the websites success

Identification of the elements/features that are responsible for the success of the websites stills a major challenge. There are different features and characteristics that should be considered for the design of a successful website. A lot of academic studies have been conducted to investigate the main characteristics that affect the website's design quality. Choudhury and Choudhury (2010) have identified 13 important elements which control the e-commerce websites (i.e. online stores). These element are "security, appearance, adequate information about products and services, speed in downloading the pages, navigation friendly, search option/search engine, hyperlinks to other information, information on member facilities, history and profile of the company, ability to obtain information in limited number of pages instead of browsing several pages, option for providing feedback from customers, visitor statistics, and availability of interactive online activities".

Garett et al. (2016) have reviewed the most important elements that affect the website design and user engagement. Their review was based on the elements frequently used in thirty-five published technical reports. They found twenty distinct design elements commonly discussed in the previous researches that affect website quality, namely organization, content utility, navigation, graphical representation, purpose, memorable elements, valid links, simplicity, impartiality, credibility, consistency/reliability, accuracy, loading speed, information/data, interactivity, strong user control capabilities, readability, efficiency, scannability and learnability. They concluded that among the twenty design elements, only eight elements mentioned most frequently (navigation, graphical representation, organization, content utility, purpose, simplicity, and readability). Besides the aforementioned fives elements of the website success identified by Palmer (2002) and according to other studies (Petre et al., 2006; Gao & Li, 2018), the present research select ten elements of websites design and include them in the WDQI. These elements are capacity and diversity of information, information modification and update, interactivity, reliability, usability, use of valid links and hyperlinks, clarity/simplicity, use of multimedia, navigation and its tools and loading speed.

Some features or elements of the websites design were excluded due to different reasons. It is believed that there are some elements posed by the previous researches are repetitive and interrelated. For example, elements like organization, arrangement, layout, and sequencing are all belonged to navigation as Palmer (2002) claimed. Furthermore, these four elements may be related to the clarity and simplicity of design. However, the present study takes into account both elements (navigation and clarity and simplicity of design) in the index. Moreover, the capacity and diversity of information may reflect the efficiency of websites. As for elements related to the impartiality, loyalty and accuracy presented by the previous researches, they were excluded because they are relative and difficult to measure. Besides, they have recorded the lowest

proportions in the previous researches (Garett et al., 2016).

Transformation using a gradient appraisal scale

The ten elements that have been identified previously were transformed into a dimensionless number using a gradient scale. The scale was built as shown in Figure 2. It was divided into five gradients starting from weak to excellent, and values were assigned to each gradient. The numbers assigned for weak, moderate, good, very good and excellent are 25, 50, 70, 80 and 100, respectively. The reason behind giving the lowest value of 25 for each element that indicates "weak" in the gradient scale is that the websites should not have a zero value in the assessment process.

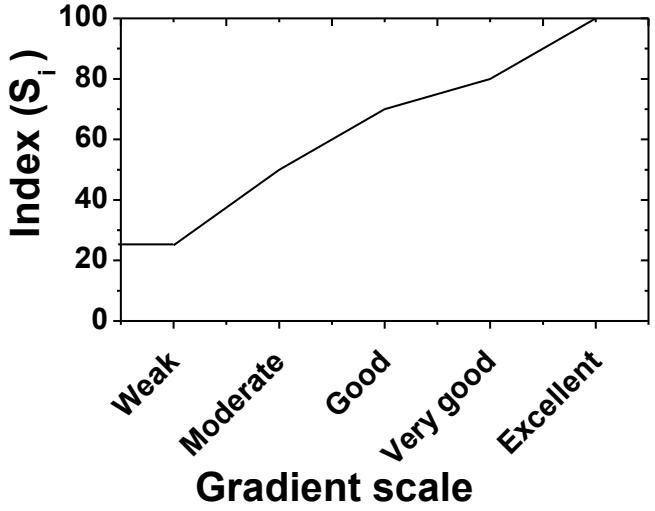

Figure 2. Transformation index for the ten selected elements

Assignment of weight for each element (Establishing weights)

The next step is to assign weights for each element. This step was included in the index calculation due to the fact that the 10 identified elements do not have the same degree of importance. Accordingly, different weights have been set for each element of the website design quality in order to distinguish the significance of the elements. A panel of expert opinions was used in the area of competence. They were asked to assign a temporary weight to each element ranged from 0 to 1. Zero represents the least importance and one indicates the most important. All other temporary weights were obtained by calculating the arithmetic mean rating of the experts. Each temporary weight was then divided by the sum of all the temporary weights to arrive at the final weight. Table 1 shows the weights given to these 10 elements based on expert's opinion.

Table 1. Weights assigned to the selected elements

Seq.	Features/variables	Temporary Weights	Final weights (w_i)
1	Capacity and diversity of Information	1	0.12
2	Information modification and update	0.9	0.11
3	Interactivity	1	0.12
4	Reliability	0.9	0.11
5	Usability	0.9	0.11
6	Use of valid links and hyperlinks	0.7	0.08
7	Clarity/simplicity of design	0.8	0.10
8	Use of multimedia	0.6	0.07
9	Navigation and its tools	0.8	0.10
10	Loading speed	0.7	0.08
Sum of Weights		**8.3**	**1.0**

Index Aggregation

This step is to aggregate the values obtained from the index (S_i) for each element along with its weight using an aggregation formula. For this purpose, different formulas are available such as additive aggregation (e.g., arithmetic mean), multiplicative aggregation (e.g., geometric mean). Many modified versions of aggregation methods have been proposed by different researchers and institutions (SRDD 1976; Dojlido et al., 1994; Pesce & Wunderlin 2000; Debels et al., 2005). In the present paper, different aggregation functions with unequal weights were used for index aggregation as follow:

The simple additive aggregation with unequal weights that proposed by Brown et al. (1970)

$$WDQI = \sum_{i=1}^{10} S_i w_i \qquad (1)$$

The simple multiplicative aggregation with unequal weights that proposed by Brown et al. (1973)

$$WDQI = \prod_{i=1}^{10} S_i^{w_i} \qquad (2)$$

The modified additive aggregation with unequal weight that suggested by Tyson and House (1989).

$$WDQI = \frac{1}{100}\left(\sum_{i=1}^{10} S_i w_i\right)^2 \qquad (3)$$

where WDQI is the final value of the index, w_i is i_{th} weight (final weight given in Table 1) and w_i is the i_{th} element. The weights (w_i) indicate the relative importance of w_i.

Final index value interpretation

The final step is to interpret the final index value. The interpretation of the index is divided into five classifications and presented in Table 2.

Table 2. Final WDQI value interpretation

Final index value range	The quality of website design	Description
90-100	Excellent	The website is perfect
80-89	Very good	The website is successful with some exception
70-79	Good	The website needs minor improvement
50-69	Moderate	The website needs major improvement
25-49	Poor	The website needs an essential and fundamental change

Application of WDQI to different websites

The proposed WQDI was applied to three websites, namely the University of Babylon website (W_1), the Iraqi Ministry of Education (W_2) and Zain Iraq Telecom Company website (W_3). They were selected randomly by the author to assess the quality of websites in various fields such as an academic, governmental and private sector.

The results of transformation process for the selected Websites are shown in Table 3. The calculated results of WQDI are shown in Figure 3. Based on the aggregation function suggested by Brown et al. (1970), the website quality classification for selected websites was found "very good" for W_1, "Moderate" for W_2 and "Good" for W_3. The same was obtained when using the aggregation function proposed by Brown et al. (1973) as shown in Figure 3. The calculated WQDI based on Tyson and House (1989) aggregation function revealed that the website quality classification for selected websites was found was found "Moderate" for W_1, "Poor" for W_2 and "Moderate" for W_3.

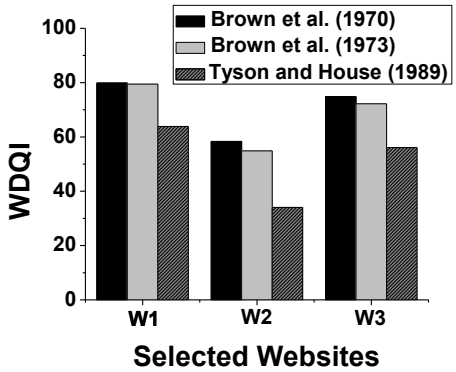

Figure 3. The results of WDQI for the selected websites

Table 3. Results of transformation process

Seq.	Elements/ Features	Weak 25	Moderate 50	Good 70	Very Good 80	Excellent 100
1	Capacity and diversity of Information		W_2		W_3	W_1
2	Information modification and update			W_2	W_1, W_3	
3	Interactivity		W_2		W_1, W_3	
4	Reliability				W_1, W_2, W_3	
5	Usability			W_2	W_1, W_3	
6	Use of valid links and hyperlinks	W_2		W_1	W_3	
7	Clarity/simplicity of design			W_2	W_1, W_3	
8	Use of multimedia	W_2		W_1, W_3		
9	Navigation and its tools		W_2	W_1	W_3	
10	Loading speed	W_3			W_1, W_2	

W_1: University of Babylon Website, W_2: Ministry of Education Website, W_3: Zain Iraq Telecom Company Website

The results of WDQI showed that the University of Babylon website (W_1) has the highest quality. The major elements that affect the WDQI for the W_2 are the capacity and diversity of information, interactivity, use of valid links, use of multimedia and the loading speed, whereas, the latter was the only element that affects the WDQI for W_3.

According to Figure 3, it is clear that the aggregation function of Tyson and House (1989) does not reflect the actual state of the selected websites. This study recommends using either the aggregation function suggested by Brown et al. (1970) or that of Brown et al. (1970). The output of WDQI when using one of these functions has provided realistic results in comparison to the reality of selected websites.

The results of WDQI revealed that the W_1 was "very good" indicating that "the website is successful with some exception", W_2 was found as "moderate" indicating that "the website needs major improvement", whereas, W_3 was "good" indicating that "the website needs minor improvement" (see: Table 2). W_3 has the poorest quality among other websites. W_3 was ranked as moderate in case of capacity and diversity of information element (Table 4) because of the limited information in the site, especially that the ministry website represents many directorates and schools in all governorates of Iraq, where it was weak in the coverage of information about the directorates, schools and scientific and educational activities. Interactivity was ranked as moderate due to the limited interaction between the Ministry's website and its various institutions and issues related to scientific and student affairs. The use of valid links and hyperlinks element was ranked as weak due to many invalid links in the website.

The proposed WDQI can be used as a tool to measure the quality of websites in a simple and easy way. It is a simple and easy-to-understand tool for website designers, postgraduate students, and specialists in the field. Moreover, it may provide valuable information about the websites, and can be re-applied on the same website for the purpose of monitoring improvements on the website. Furthermore, the proposed index is flexible in the process of addition or deletion of elements, considering that these elements could be changed and updated in the future. If some elements are modified, added or deleted, only the process of weights assigned to each element (step 3) should be reformulated.

However, assessment of websites quality design using the proposed WDQI may be subject to personal judgments through the use of step 2 in WDQI (Table 1). To avoid subjectivity, many techniques can be used. The most popular one is the Delphi method which defined as the process of forecasting framework based on the results of several rounds of questionnaires sent to a panel of experts. Linstone and Turoff (2002) have also defined it as "a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem."

The present study may be extended in the future by developing specified indices for assessing the quality of commercial or academic websites. The current study focused on general elements that can be applied to all sites. Future studies can go in deep by identifying special elements such as social presence and telepresence identified by Gao and Li (2018) to assess the websites quality of online shopping website.

Conclusions

This paper comprised the development of WDQI to assess the quality of websites. Based on the experts' opinion, ten elements of websites design were explored to have the highest impact on the website design quality. Three types of aggregation functions with unequal weights were used to calculate the final value of the index. WDQI was applied to assess the quality design of three websites. It was found that only two aggregation functions can be used to calculate the final value. The outputs of these functions have provided representative output in comparison to the assessed websites. The proposed index is easily updated and modified by deleting or adding or replacing certain website quality elements. WDQI can be used as an efficient tool by the designers and engineers and it can be applied to any website for the purpose of advancement.

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