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Usability study of a methodology based on concepts of ontology design to define website structures

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ABSTRACT

Today, Web site design is used to make sites useful to users, with accessible functions, resources and information. Therefore, that design involves use of methodologies that allow an adequate structuring of them resources and organization, permitting users to access them quickly, easily and intuitively. This research consisted of a usability study oriented to website structure designers using a methodology based on concepts of ontology design. This study includes a planning to evaluate the design and the structure of website in aspects such as: ease of use, efficient access to information and performance on the tasks focused to total satisfaction of end user. Heuristic tests were used as diagnostic tools to evaluate usability of website design structures; these were supported by a heuristic evaluation guide and in the Sirius methodology**[3]**. The results obtained from them, allowed us to detect opportunities for improvement and optimization in website design, and in refining the Web interface oriented to end users.

Keywords—*Ontology, heuristic tests, usability, websites*

I. INTRODUCTION

Web design includes: technical development, structure of information and visual design [11]. However, design of an accessible website requires an architecture model that is well structured and organized, functional, with useful content; and that involves usability since the beginning of its design. This is a quality attribute that measures ease of use in user interfaces (IU) [8].

This work describes a usability study directed to designers of websites structures, where they will apply an adapted methodology [13], with the objective to provide facility of understanding and use of the website structure, efficiency and efficacy to find information, functionality and satisfaction of website users.

II. DESCRIPTION OF PROBLEM

Evaluation of the usability is a process that establishes a reliable measure of the facility with which users interact with a system [5]. Therefore, usability evaluation is an empirical study with real users of the proposed system; this has the target of providing feedback on software development during iterative development life cycle [12]. The most important purpose of process or product evaluation is not to demonstrate its functionality but to improve it [4]. These concepts of usability are summarized in figure 1:

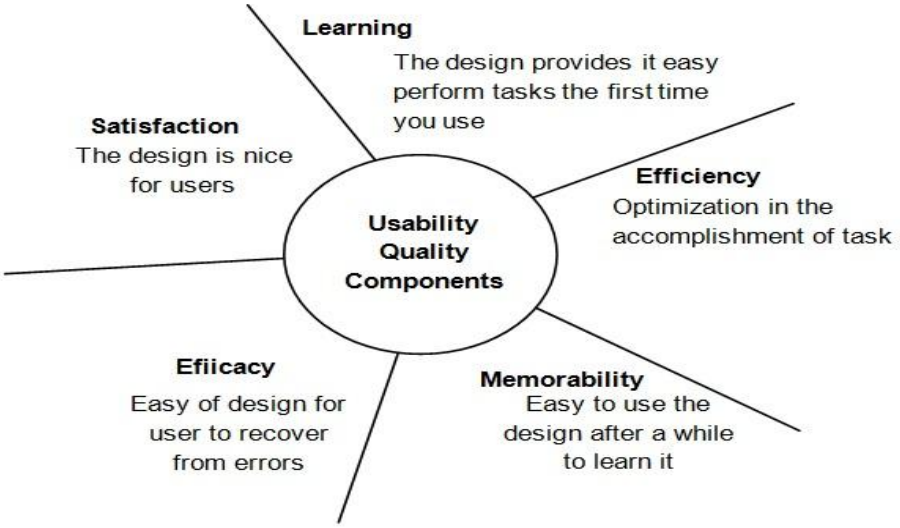

Fig. 1. Diagram that defines five quality components of usability

In a previous work was defined a methodology of website design based on concepts of ontology [2] oriented to obtain a more usable website design; experimental stage to determinate its possible benefits was missing. This problem is present in mostly proposed methodologies.

Subsequently, in this research was realized an evaluation of the understanding of the users and the acceptance of the mentioned methodology [2], making it some improvements based on ontology design concepts [14] [10] and didactic techniques [6][8], this delivered as a result an adapted methodology [13].

III. Evaluation Methodology

Our proposal is to design and to apply an evaluation schedule to measure degree of usability of the design of the structure of the website using the adapted methodology. Evaluation will help to identify aspects that are part of the design of the site, determining its simplicity and ease of use, efficiency and effectiveness in information access.

These assessments will help to identify opportunities for improvement and optimization in the adapted methodology, and in completing the design of user-friendship Web interface. These tests was oriented to measure aspects of usability of an accessible design, functionality to accomplish specific tasks of search of information, and finally total satisfaction of the end users.

In this study, heuristic tests [7],[3] has been applied; contemplating in these strategies usability metrics applied in Web design [9]. Two teams of designers were involve in define the structure of a school website, first one using adopted methodology and the other group by means of alternative method [1]. To avoid any statical bias, both teams use Adobe Dreamweaver CS5 and HTML to design the Web structure.

A. Evaluation of usability applying heuristic tests

The general description of the group of testers can be seen in table I, as well as description of material and equipment used is shown in table II. Mechatronics Laboratory of the Faculty of Engineering of the Autonomous University of San Luis Potosí was used to carry out the tests.

TABLE I. GENERAL INFORMATION OF THE GROUP OF EVALUATORS IN THE USABILITY OF THE WEBSITE DESIGN

Item	Description
Education Level	6 graduate, 4 Master degree students
Age	From 35 to 40 years old
Gender	6 women, 4 men

TABLE II. MATERIAL AND EQUIPMENT USED IN EVALUATIONS

Equipment and software	3 Laptops Hewlett Packard, 2 Laptops Toshiba and 1 Laptop Acer Epson Power Lite S6+ Projector. Operating system: Windows XP and Windows 7. Internet browser: Mozilla Firefox, Internet Explorer, Google Chrome.
Material	Heuristic test documentation (Digital and printed) Blank sheets, pencil.

Valuation instruments were delivered to evaluators for the adapted methodology and the alternative website design; they carried out the following activities:

- They opened Internet browser with each one of websites to be evaluated
- They accessed and interacted with each one of websites
- They applied the heuristics tests
- They registered the data obtained of the evaluations through Likert scales.

Afterwards, the records obtained were normalized, using statistics for their presentation as percentages. The meaning of the percentage scale of heuristic in evaluated pages was 0, for minimum expression and 100 for maximum expression.

IV. RESULTS AND ANALYSIS OF THE EVALUATIONS

The results of the heuristics (see table III) shown that the structure of the website with the adapted methodology has a more coherent, familiar and intuitive design (5); also, there is a better organization, homogeneity and visualization of information on its pages (2). These outcomes confirm a web design more oriented to the end-user (3).

TABLE III. AVERAGES OF HEURISTICS IN USABILITY EVALUATION OF THE WEBSITE STRUCTURE

No.	Heuristics generals	% Global percentage	
		Adapted methodology	Alternative method of Web design
1	Are the objectives of website specific and well defined?	92	92
2	Are the contents or services offer by website showed in a accurate and complete way?	96	88
3	Is the general structure of website oriented to end user?	88	80
4	Are the look & feel of website oriented to the objectives, characteristics, content and services?	84	80
5	Is coherent general design?	96	92
6	Is recognizable website general design?	88	88
7	Is website update periodically?	92	76

Heuristics of identity and information (see table IV) show that the web design using adapted methodology obtained improvement in identification of site and its objective (8, 10, 11) with a visible and informative logotype that supports this characteristic (9).

TABLE IV. AVERAGES OF HEURISTICS OF IDENTITY AND INFORMATION IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of identify and information	% Global percentage	
		Adapted methodology	Alternative method of Web design
8	Is website identity show clearly across all its pages?	96	72
9	Is identifiable and sufficiently visible the Logotype?	100	76
10	Is the slogan really expressing that is the company and that services offer?	92	72
11	Is there a link with information about the company, website and webmaster?	96	72
12	Are there in company options for contact? (Email, telephone, postal address, fax...)	88	88
13	Is clearly showed information in articles, news, reports, etc.? About the author, sources, date of creation and review of the document.	88	84

In heuristics of labeled (see table V), design of the website using our methodology was more friendly and familiar (14), because the information on its pages was transmitted with a clear and congruent language (15, 16). This validates a website interface more accessible and user-oriented (17).

TABLE V. AVERAGES OF HEURISTICS OF LABELING IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of labeling	% Global percentage	
		Adapted methodology	Alternative method of Web design
14	Is language used in website similar to users' language?	88	72
15	Is being used a clear and concise language in website?	92	80
16	Is there a friendly, familiar and intuitive language in website?	92	76
17	One paragraph = one idea, it is equal to one informative object.	96	88

In heuristics of structure and navigation (see table VI), the design applying first methodology shows a progress in organization of hierarchic structure (18), this facilitates to identify elements that compose them (19); and also give support to the experience of users in navigation through its pages (22), end-users recognize more quickly path to reach required information (24).

TABLE VI. AVERAGES STRUCTURE AND NAVIGATION HEURISTICS IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of structure and navigation	% Global percentage	
		Adapted Methodology	Alternative method of Web design
18	Are you obtaining most appropriate organization and navigation structure with this design?	96	92
19	Does hierarchical structure maintains a balanced between depth and width?	96	88
20	Are all the clusters of nodes connected?	92	88
21	Are the links recognizable easily? Is state attributes indicated? what was visited, what is active, etc.	92	88
22	Has been controlled number of terms by element in navigation menus to avoid overload memory?	96	92
23	Is the answer of the system predictable before clicking on link?	88	84
24	Has been controlled in the design that there is not broken links?	100	88
25	Are there navigation elements that guide to user about where he is and how to return?	92	84
26	Are images recognized as links? Do these images include a title tag describing the target page?	88	84
27	Are not there redundant links?	96	88
28	Are there in design orphan pages?	96	88

The results heuristics of Lay-Out page indicate that web design of adapted methodology presents a better distribution of its elements (29, 30), because it was possible to identify its organization of its hierarchical structure and distribution of relations that comprise them (33); we obtain a web interface more intuitive for end-users and easy access, with properly distributing elements and avoiding visual and informative overload (31, 32); see table VII.

TABLE VII. AVERAGES OF HEURISTICS OF PAGE LAY-OUT IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of page Lay-Out	% Global percentage	
		Adapted methodology	Alternative method of Web design
29	Does the design take advantage of areas of high informative hierarchy of page to show most relevant contents?	88	80
30	Is information overload avoided in website?	92	88
31	Is clean and without visual noise the web interface?	96	84
32	Does right the use of visual space in web site?	92	88
33	Is used correctly the visual hierarchy to express "part of" relationship between elements of the page?	96	88
34	Is controlled length of the page?	88	84
35	Are there any "empty areas" on page between informative objects to rest your eyes?	92	88

In both designs, we used heuristics of search but we gave less importance to these, because it was not possible to evaluate all the necessary attributes (see table VIII).

TABLE VIII. AVERAGES HEURISTICS OF SEARCH IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of search	% Global percentage	
		Adapted Methodology	Alternative method of Web design
36	Is the search element easily accessible in website?	88	72
37	Is the search element easily recognizable in website?	88	76

Through the evaluations heuristics of multimedia elements, were observablein both web designs that image objects have a suitable distribution (44, 45), this reveals that web design of the adapted methodology shows improvement in the size and identification of these (42); see table IX.

TABLE IX. AVERAGES HEURISTICS OF MULTIMEDIA IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of multimedia elements	% Global percentage	
		Adapted Methodology	Alternative method of Web design
42	Are the photographs well-trimmed? ¿Are these understandable? Had they a proper resolution?	96	88
43	Are visual metaphors recognizable and understandable by any user?	92	84
44	Do the images or animations provide some type of value added?	88	88
45	Has website been avoided the use of cyclical animations?	96	92

Evaluating accessibility heuristics was observable in both website designs (see table X) use of legible and visible fonts to easy-reading (46, 47), as well as compatibility of website with different browsers (50); also in any website was not necessary to install additional software applications (51); however, the web design with our methodology simplified this work of interaction to end-users with one improved

interface because it was taking care of distribution of elements, handling colors in its design (48), and images visualization with suitable size and description of the pages inside them (49).

TABLE X. AVERAGES OF HEURISTICS OF ACCESSIBILITY IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of accessibility	% Global percentage	
		Adapted methodology	Alternative method of Web design
46	Was the font defined accord the content and large enough to help in readability of text in website?	96	88
47	Do the type of font, typographical effects, line width and alignment facilitate the reading in website?	92	88
48	Is there a high contrast between the color font and background?	92	84
49	Do images include a description tag that defines its content?	84	80
50	Is website compatible with different browsers? Is website correctly visible with different screen resolutions?	92	88
51	Can the user enjoy the whole content of website without he needs to download and to install additional plug-ins?	96	88
52	Is under control website weight?	92	84
53	Could be printed without problems the website?	88	80

The web design of the adapted methodology shows an improvement against the web design alternative, in the field of control and feedback heuristics. Our approach enables navigation control allowing users easy access information (54); through a visual design more intuitive in the composition of web interface (55); see table XI.

TABLE XI. AVERAGES OF HEURISTICS OF CONTROL AND FEEDBACK IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of control and feedback	% Global percentage	
		Adapted methodology	Alternative method of Web design
54	Have the user under control the interface?	92	84
55	Is the user informed that it happens in the web interface?	84	68
56	Is the user informed clearly what is wrong and how can fix the trouble?	72	68
57	Have freedom to act the user?	80	72
58	Has been controlled the answer time?	80	64

In both designs of websites, heuristics of user-orientation was an import aspect, obtaining the data shown in table XII.

TABLE XII. AVERAGES HEURISTICS OF USER-ORIENTATION IN USABILITY EVALUATION OF WEBSITE STRUCTURE

No.	Heuristics of user-orientation	% Global percentage	
		Adapted methodology	Alternative method of Web design
59	User's orientation. Where am I? How will I return? What have I visited? What is it going to happen here? Etc.	88	72

The design of the website with our approach presents an advantage against opposite, about several evaluated usability heuristics. This means that our methodology has the benefit of maintaining a more organized and simple structure, which facilities to users access to information in less time (efficiency) and interaction with a design more intuitive and consistent for a browsing experience more satisfactory.

V. CONCLUSIONS

The results obtained from the heuristic tests in the usability evaluation of the design of the website structure with the adapted methodology show a high score in the aspect of structure and navigation of 93.8% [13] against 87.6% of alternative method [1]; in accessibility was achieved 91.5% against 87% and in control and feedback, 81.6% versus 71.2%. The general average of usability heuristics was 90.6% in our proposal in contrast to 79.9% in the alternate approach.

The results derived from the evaluations allow validate efficiency and usability of website structure designed with our methodology. These results reveal that the structure designed had the following gains:

- A better organization, distribution and structuring of their pages and elements.
- Major accessibility in its web interface for the hierarchy of the relations and its concepts, providing a more intuitive and familiar browsing.
- There is consistency in the visual design of its pages, because it unifies similar colors, legible and visible fonts.
- This design provides descriptive information in each element: images, logotype, buttons and navigation options, among others.
- It provides satisfaction to end-user; also offers control and feedback on their pages, because the user is guided and helped, so that he knows where to have to move or where to navigate, supplying required information.
- A user-oriented design, with objects and content in consideration of real requirements and needs.

REFERENCES

[1] Adobe Dreamweaver CS5. [Online] [Accessed in February 2015]; Available in: https://www.adobe.com/mx/products/dreamweaver.html?Sdid=KQPSF&mv=search&s_kwcid=AL!3085!3!47835133542!e!!g!!adobe%20dreamweaver%20cs5&ef_id=V9CkqgAABV9ir5bA:20160907233714:s#; 2015.

[2] Baños M.; "Methodology to define a Web site Architecture based in ontology design" (thesis), Morelos, México; National Center of Research and technological Development, Computer Science Department; September 2008, 114 p.

[3] Carreras, O.; "Sirius: system for Web Usability evaluation oriented to user based in critical tasks determination"; [Online]; [Accessed in February 2015]; Available in: "https://olgacarreras.blogspot.mx/2011/07/sirius-nueva-sistema-para-la-evaluacion.html"; 2011.

[4] Castillo S.; "Educacional Evaluation commitments", Madrid, Pearson Education S.A., ISBN: 84-205-3562-1, 2002.

[5] Claros I.; "Design guidelines to Usable applications design in a Web Environment"; Online]; [Accessed in December 2014]; Available in: "http://artemisa.unicauca.edu.co/~iclaros/usabilidad/ chapter3.htm"; 2006.

[6] Diaz B. F.; "Teaching Strategies for a significant Learning"; [Online]; [Accessed in July 2011]; castiAvailable in: "http://redescolar.ilce.edu.mx/redescolar/biblioteca/articulos/pdf/ estrate.pdf".

[7] Hassan Y., Martín F., "Tests with users Method"; [Online]; [Accessed in December 2014]; Available in: "http://www.nosolousabilidad.com/articulos/test_usuarios.htm"; 2003.

[8] Mayer R.; "Teaching Strategies for a significant Learning: Constructivist approach"; [Online]; [Accessed in July 2014]; Available in: "http://redescolar.ilce.edu.mx/redescolar/biblioteca/articulos/pdf/estrate.pdf"; 1999.

[9] Nielsen J.; "Usability 101: Introduction to Usability. Jakob Nielsen's Alertbox"; [Online]; [Accessed in December 2014]; Available in: "http://www.useit.com/alertbox/20030825.html"; 2003.

[10] Noy N. F., McGuinness D. L.; "Ontology Development 101: A Guide to Creating Your First Ontology"; Stanford Knowledge Systems Laboratory Technical Report KSL-01-05 and Stanford Medical Informatics Technical Report SMI-2001-0880.

[11] Powell T. A.; "Web design. The complete reference"; 2nd edition; Mc Graw Hill/ Osborne; 2002.

[12] Mayhew D.J.; "The Usability Engineering Lifecycle: A practitioner's Handbook for User Interface Design". 1999. [Online]; [Accessed in November 2014]; Available in: "http://lsi.ugr.es/~mgea/workshops/coline02/Articulos/toni.pdf"; 1999.

[13] Rosales A. "Adaptation of a Methodology to define a Web site Structure based in ontology design with a usability approach" (thesis), Institute of Technology of San Luis Potosí, waiting for grade defense date.