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Usability and Implementation of a Semantic Web for the Website Of Santa Elena Peninsula University

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ABSTRACT: *Today, universities feel concerned with respect of the content delivered as a good to the academically active society. In the present work, the necessity of implementing a semantic website and above all a usable one is shown. This could be achieved through the development of microsites and an institutional digital repository so that the content has a definite structure allowing the searchers to apply indexing by the reference of metadata types Dublin Core. Moreover, the construction of the semantic web is based on aspects such as the information of microsites, archives, digital repository, indexing methods and forms of monitoring the web and digital repository.*

A detailed study from the user perspective and from informatics applications shows the necessity to reconstruct the presented information. The structure information and the generation of new content allow the University of "Peninsula de Santa Elena" to improve notably its positional ranking web among the universities (Webometrics) not only on national level but international as well. The university has defined a unique semantic model and a policy of uploading and publishing information for college.

KEYWORDS: *Semantic web; usability; university; semantic model.*

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I. INTRODUCTION

With the boost of the Internet and the focus on the development of websites in educational centers that has changed considerably, the use of standards gave become obligatory objective for the attention of potential users such as students, teachers and researchers. All what the users want is to make the internet access more agile by investing less effort to find what they want and making the most of the contents and services provided without feeling lost in cyberspace.

We must remember that those websites, called institutional sites, should aim to be a source of information available and freely accessible, where such information on request aid serves in the knowledge enrichment and reliable sources of research.

The web has become an important communication medium which is used in all sectors of society, connecting , organizations, people, and knowledge through their shared interests, forming "subject focused networks" [1].

When you desire to improve the contents organizations and link the structure of a virtual community, there is an important task for administrators that are relying on the analysis of data generated by the community. However, you may need to analyze large amounts of data in short periods of time. To resolve this problem, the Social Network Analysis (SNA) is using an automated analysis to gather critical information on the structure of the community based on the relations between the community members [2]. Another solution would be to use data mining, such as web mining (WM), even though we lose the structure of social interactions, you might find interesting patterns in text messages from members or instead find browsing patterns [3].

Today, a term widely used in recent years, whose meaning is very general and lends itself to discussion, is the usability that is a measurement of the quality of the experience a user has when interacting

with a product or system. For us, it is interpreted by the satisfaction of Internet users using a website. The standard ISO 9241-11: 1998 defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [4,5].

Following Ferre Grau (2001), a system is linked to the usability of the users´s specific needs and conditions. That is, the usability of the system is not an inherent attribute of the software that cannot be specified independently of the environment and its users use [6]. The usability evaluation ensures that these products are easy to use, effective, efficient and satisfactory for users [7].

In the development of informatical applications centered in the user, the usability appears as a method of development of applications based principally in the web that plays an important role in the architecture or structure of the information and the management of the content. This is what has motivated and aroused considerable interest with respect to the integration and evaluation of usability in the design and implementation process and in the same application usage [8].

In particular, the educational websites must provide spaces that facilitate the teaching – learning. It is highly important to offer usable portals to teachers / researchers and students in order to achieve their objectives without worrying about the tools they are using, in this case, website [8].

In the present work, the reconstruction of a university website is proposed with a unique semantic model allowing the structuring and creation of uploading/publishing information. Moreover, different investigation methods have been used to achieve our goal. Thus, the university gives its society a semantic website that allows easy and quick access to information.

Usability cannot be defined as a simple attribute of a system, because it will involve different aspects depending on the type of system to build. Efficiency and usability aspects (number of tasks that can be performed per hour) are not relevant for this type of systems, while the ease of learning is vital to the success of the system.

Methods for evaluating the usability as it can be reviewed in [9] are those that reflect an analysis of the tasks that have been verified, of failed tasks and of those tasks that never tried, also, types of user errors, task patterns in time, etc.

Cite as an example, the software used by a telephone operator to collect the messages to be sent to a pager. It may require a period of considerable training, but the fundamental interest is that it can perform each operation in the shortest possible time (efficiency) to reduce the time waiting for customers using the service [10,11]. These different aspects of usability are called usability attributes [12].

1.1. Usability attributes

Usability is an abstract quality to be directly measured. In order to study the usability, it is usually broken down into the following five basic attributes defined in Table 1..

Some of these attributes do not contribute to the usability of the system in the same direction. It may occur that increasing one of them has the effect of decreasing another. For example, this can occur with ease and efficiency of learning. You must make the system design carefully to realize both high ease of learning and high efficiency. The use of accelerators (shortcut keys) the most common solution to combine both usability attributes [12].

A useful website is one that shows everything in a clear form and easy to be understood by the users (Figure 1). Although it is impossible to create a website that is clear and efficient for each of the users, we should strive to make it the most clear possible to reduce maximally any confusions [13].

In the research project "Implementing metadata on the website of the Peninsula University of Santa Elena (UPSE) by means of a digital repository and development of micro-sites semantic", it was observed that information access from the part of students and teachers relies on the availability and on proper information structure.

In fact, the UPSE had a web site that lacks developments standards and above all that suffers from a poor usability making it responsible for the waste of user time surfing the net. The user becomes unmotivated to explore and navigate which results in losing interest for the considerations of complications and dullness. Taking into consideration the facts mentioned above, the aforementioned project develops. The information was concentrated in a single domain and there was no information classification or categorization. In comparison with everything that can be offered by the Internet today, there were no resources available for research and/or consultation.

The website showed many weaknesses and lacks organizational structure data. Moreover, there were no downloadable resources or consultations for the use of students and / or teachers. This problem has made the institutional web unattractive and its position in Webometrics was not the best (40 of 68). This metric represents the "World Universities Ranking on the Web" initiative Cibermetrics Laboratory, which belongs to the Higher Council for Scientific Research (CSIC), the largest national research center in Spain [14].

The lack of structured metadata that would allow us to find, manage, control, understand and preserve information in time, causing minimal access to pages to find the desired data. This system also was not a semantic web. By using semantic web, it is possible to filter the information automatically and yet precisely. It is necessary that the information relying on the web is understandable by the machines themselves.

Figure 1. Relation between the usability attributes and the user vision.

As part of the universities, we can see that each university promotes its products and services with Semantic Web of Universities as reflected in the different rankings of Higher Education. In this sense, each community can interact with its members through the use of specialized metadata in the statement of flows ofacademic and research knowledge.

The semantic web of a university is a unit that serves to promote the products delivered by the institution as a common good within the area market of Webometrics investigation.

The development of a semantic web is changing the nature of how information is produced and shared. In addition to that, the interactions between man and man and machine-machine are still very common today. The success of these interactions is the structure of data allowing a mechanical reading, especially when it comes to a large volume of information and interconnecting systems [15].

The Semantic Web has been driven by Tim Berners-Lee, creator of the World Wide Web, who tells us that the concept of documents understandable by a computer does not imply a certain artificial intelligence that enables machines to understand human language. This only indicates the ability of a machine to solve a defined problem by performing operations on existing data [16,17].

This work will allow us to show the scope behind implementing the project mentioned in the Santa Elena Peninsula University and reflected in the Schools, Careers, research centers and other departments that are part of the Santa Elena Peninsula State University. In fact, there is a growth in the size or number of pages that can be created in the micro-sites using Dublin Core metadata type references [18]. For each of the different cases from web pages to files that can go; as undergraduate thesis, graduate theses, articles or papers, databases, legal documents of the university, among others interest of the University.

II. METHODS

The archives of the semantic web need to express information flexibly. The information cannot be packaged in tables such in a relational database or hierarchical, as in Xtensible Markup Language (XML) [19].

The idea of the semantic web popularized once it has been published [20]. The authors explain simply their idea of semantic web and how that should be done. Further, Berners-Lee (2000) proposes that the architecture of the Semantic Web can be represented in the way shown in Figure 2 and detailed in [21].

We must remember that the development of the Semantic Web will depend on the use of structured languages such as Extensible Markup Language (XML) and the Resource Description Framework (RDF). These are the same that will equip identity or logical meaning to pages, files, resources or content that allow the machines to know its meaning and turn the screen display. Likewise, the use of Web Ontology Language (OWL) will allow us to build ontologies [22].

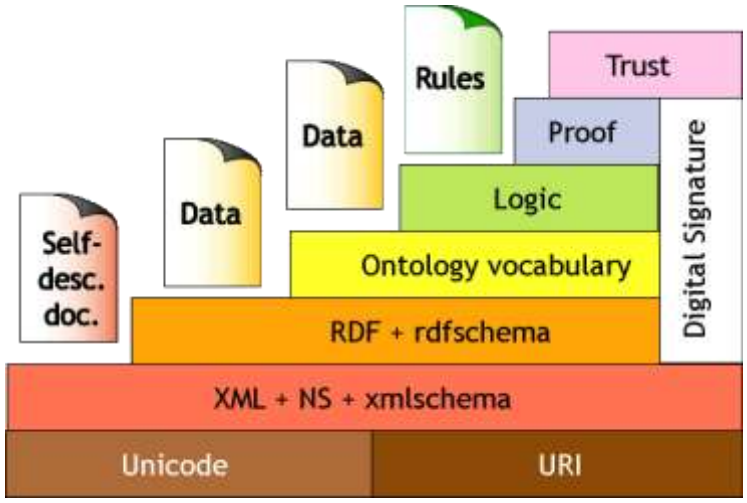

Figure 2. Architecture of a web semantic[20].

The World Wide Web Consortium (W3C) defines the Resource Description Framework (RDF) as a platform to present information on the web and has become in its turn the standard language where the XML pages can locate metadata schemas of RDF and XML. This provides a mechanism for interpreting and understanding application documents with a descriptive vocabulary [23].

The methodology used is that of the documentary and exploratory research, which helps us to analyze the information and raise the university after making an analysis of the current state and the portal on a general level model structure of semantic web. This will be subsequently applied to microsites and repositories. Part of the model includes the installation of modules with their respective configurations and use of standards, such as Dublin Core, to improve the Search Engine Optimization (SEO). Furthermore, our investigation will be linked to the methodology implemented in Webometrics Info/Methodology. This will be done through indicators Size, Rich Files, Scholar and Impact.

In addition, a digital repository that facilitates the classification and categorization of information by agencies or departments will be implemented. These are the same that will be called within the DSpace [24] tool as communities or sub-communities and that contain files named collections, as it is shown in Figure 3.

You must remember that you can define "n" communities, "m" sub-communities and therefore "o" collections. This is due to the fact that it is being constituted by a set of tools to manage digital content according to the Reference Model for an Open Archival Information System (OAIS) [24].

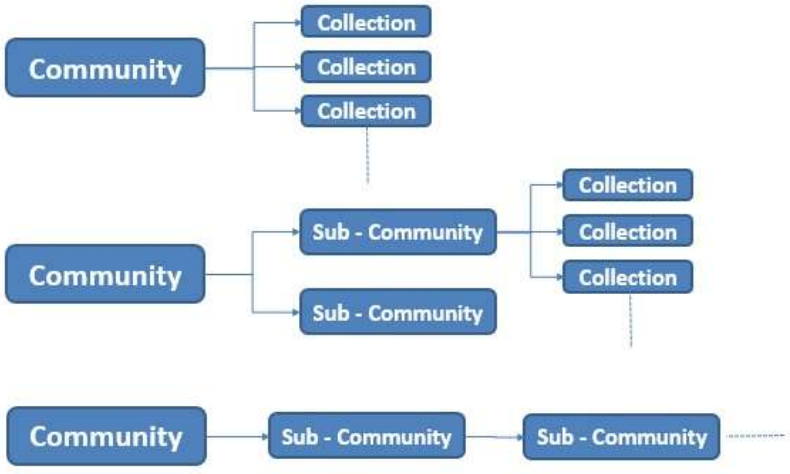

Figure 3. Repository Structure.

1.2. Tools for the implementation of Semantic Web

Making an analysis of the necessary tools to convert the website of the UPSE into a semantic web, it was taken into consideration the Content Management System (CMS) allowing the user easily to organize, manage and publish their content with a quite high level of customization which provides great support in security, plug-ins,

documentation and ease of publication, etc. [25]. Among the managers of open-source content, are considered Joomla, WordPress and Drupal [26].
As a professional in computer security, one of the recommendations is to validate the use of a CMS that gives us security at the time of publication and that turns the information stored on our servers to be accessed by the web. Then safety testing shows vulnerability data specialized in web applications [27]:

- Watchfire *(www.blog.watchfire.com)*says that 90% of the websites are vulnerable to attack
- Gartner *(www.gartner.com)*says that 75% of the attacks are realized in the application layer Open System Interconnection model (OSI).
- Symantec *(www.symantec.com)*says that 78% of the exploited vulnerabilities affect the web applications easily.

After a comparative analysis of web security systems content management made in 2013, it is obtained that the greatest concern of content managers as to be vulnerable, is the use of not certified plug-ins compromising the security of websites.
Further according to the results obtained in terms of directories containing confidential files, it states that both Joomla and Drupal expose a greater number of directories, whereas WordPress does not [28].

Although Drupal turns out to be a little vulnerable by exposing directory with confidential and/or sensitive information, we can determine that the CMS will provide us with a greater spread of the resources that are shared across sub-domains of the same domain and management sub-domains which will be relatively independent [29]. Further, the use of a CMS like Drupal allows us to obtain excellent results as those shown in [30] where it should propose the implementation of a single sign-on and that will be represented based on the fees generated content each the departments.

2.2. Techniques and instruments investigation.

Within the research techniques and instruments, we will use the observation and interview.The observation will allow us to gather information by simply analyzing the information and interpreting without modifications to reach a conclusion later [31]. In the same way the interview, which will be addressed to the administrative area of each faculty or center UPSE allows us to collect relevant information, either in quantitative or qualitative research [32].

The construction of the UPSE semantic web will be based on the following aspects: microsites information, files, digital repository, indexing methods, and form of monitoring the web as the digital repository. Once the weaknesses of the UPSE web are observed, the construction of general model of semantic web for the UPSE starts, as shown in Figure 4.

The construction of the semantic web of the UPSE is based on the following aspects: information of the microsites, archives, digital repository, indexing methods.For the upload and publication of information to the semantic microsites, digital repository is designed and policies are listed in Table 2.

Within the parameters set out in Table 2, depends on the correct indexing seekers and in its turn, the ease of finding information by Internet.

To improve the Search Engine Optimization (SEO) Drupal installed and configured modules that can generate tags, taxonomy, verify Uniform Resource Locator (URL) among other features, the same as detailed in Table 3.

To carry out the monitoring of growth, activity and web positioning in the Ranking of Universities tools like Google Analytics, Webmaster Tools and Google Webometrics were used. Google Analytics (GA) is a free web analysis tool that provides Google, and is currently the most widely used. Additional Google Analytics uses or displays graphics control boxes allow project managers to measure and monitor the performance of the web site [33,34,35].

Webmaster Tools is a free service for webmaster allowing web developers to check indexing their websites on the Internet and optimize visibility. For that Google has developed the Blog for Webmasters [36].

Webometrics is a service provided by the Laboratory of CSIC Cybermetrics where only the quantitative analysis of the Internet and web content is carried out, especially for those related to the process of content generation and scholarly communication of scientific knowledge service [14].

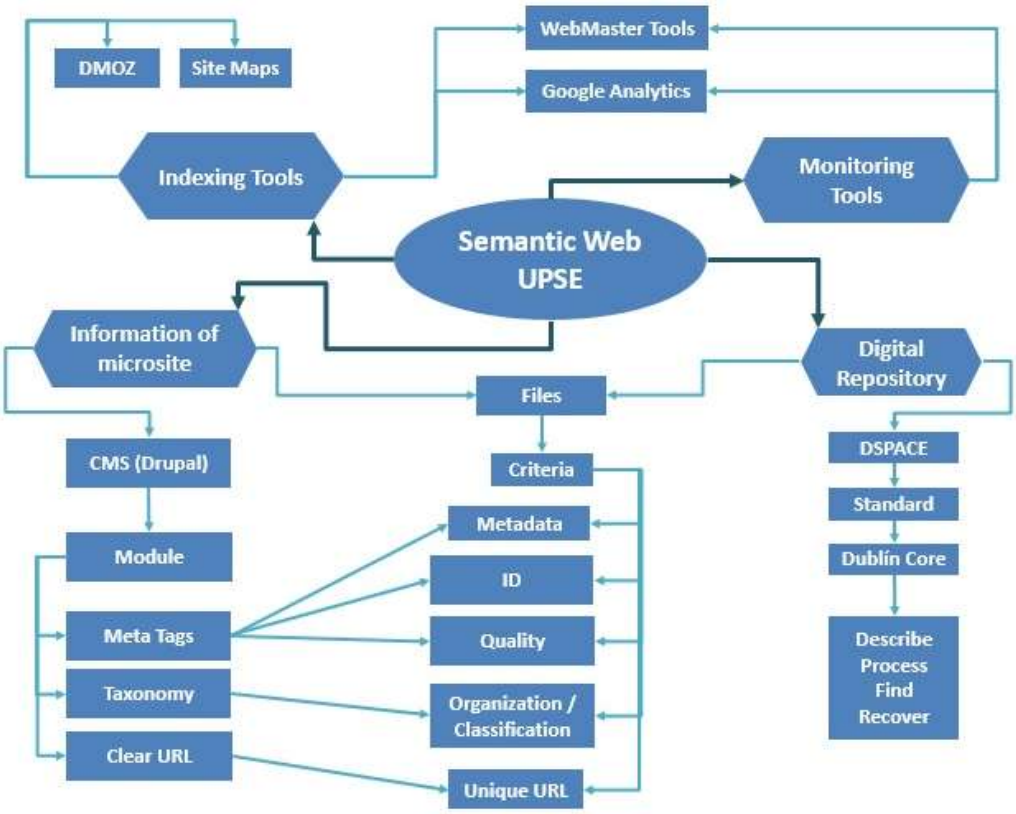

Figure 4. General Model of the Semantic Web UPSE.

III. RESULTS

At the beginning of our investigation, many weaknesses on the UPSE website were observed. Using the observation sheets that are clearly shown in Table 4, the state in which the Digital Repository State University Peninsula Santa was Elena. You can notice that they were generating metadata, but they did not have an optimum format. A problem affecting the web presence was also found; it is to have a few files stored. Further information is not regularly updated and visibility of the repository does not improve.

Regarding the situation where microsites were and applying the respective observation sheet in Table 5, the following conclusions can be obtained: a lack of taxonomy, a lack of metadata, no standard use, outdated information, and presence of lost links and the loading speed of microsites that was not optimal.

Finally using the above tools, like Google Analytics, WebMasters Tools and Webometrics, we have fairly poor results with regard to indexing in Google Scholar, location of the repository in the Ranking of Repositories Webometrics and even indexing in Google. This is making the UPSE web position the 40th of 68 at a national level [37]. The digital repository did not even appear in the ranking of repositories at the national level [38], as shown in Table 6.

In respect with the obtained results by the use of interviews, with 2500 people distributed as such: 110 administrative, 155 teachers and 2235 students, different results have been obtained that would serve to reach exact conclusions for the UPSE web changes. The major results are detailed in Table 7.

From there, 89.48% agree that the information published is not updated frequently and 89.36% said that it was not enough for the consumption of the academic community. Additionally, results on the level of accepting the information that will be published on the web of the UPSE are quite significant and are shown in table 8. In table 8, accepted results are shown according to the type of webuser that meet in its major part with the importance of the information of publication services, events and attention schedules. Figure 5 reflect the global results achieved by our investigation.

In the same form, 78.95% consider the indexing of seekers and the ease of academic information accessibility offered by the UPSE to its society to be vitally important. Thus, comes the necessity to include semantic terms on the web. In the same way, 100% of the interviewed agree on the importance of the presence of the University among the universities webrankings at national and internationals levels and on the technical implementation to improve its position (Table7).

After having implemented the different techniques and research instruments detailed above, monitoring results to the semantic web UPSE obtained are quite significant, where only one primary domain is handled at

present (2016) (www.upse.edu.ec). Microsites are created within the same domain with the use of semantic terms for proper search engine indexing and reflect in their turn a significant improvement in its position in the Webometrics Ranking given by universities. Moreover, the insertion of the digital repository in the Ranking of Digital Repositories results in a pretty good position (Figure 6).

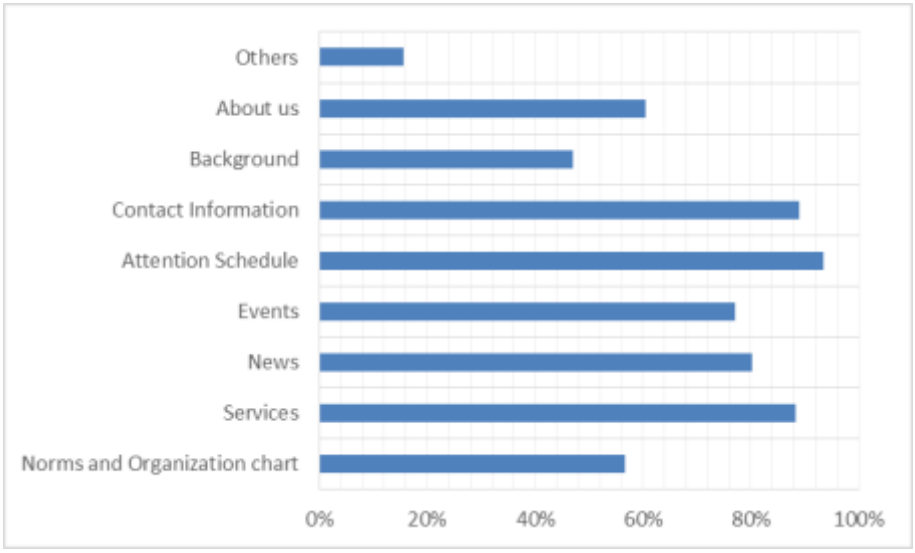

Figure 5. Necessary information to publish on the UPSE web.

Ecuador

Ranking	Ranking Mundial	Universidad	Det.	Presencia (Posición*)	Impacto (Posición*)	Apertura (Posición*)	Excelencia (Posición*)
1	1844	Escuela Superior Politécnica del Litoral		457	1910	292	3092
2	1939	Pontificia Universidad Católica del Ecuador		473	3492	731	2486
3	1962	Universidad San Francisco de Quito		1326	5169	1929	1719
4	2089	Universidad de Cuenca		670	2939	1193	3303
5	2214	Escuela Politécnica Nacional		555	1995	1188	3567
6	2286	Universidad Técnica Particular de Loja		770	1997	1743	3567
7	2928	Universidad Estatal Península de Santa Elena		4228	739	3306	5484
8	2940	Universidad de las Fuerzas Armadas ESPE (Escuela Politécnica del Ejército)		446	4161	696	4116
9	3389	Universidad Católica de Santiago de Guayaquil		4329	8568	2111	3047
10	3671	Universidad Central del Ecuador		1084	6706	1925	4116

Ecuador

ranking	World Rank	instituto	Size	Visibility	Files Rich	scholar
1	155	Repositorio Escuela Superior Politécnica del Litoral	57	345	117	151
2	195	Repositorio Universidad Politécnica Salesiana	58	454	240	145
3	227	Repositorio Digital de la Escuela Politécnica del Ejército	55	489	214	170
4	268	Repositorio Institucional Universidad de Cuenca	230	704	307	59
5	345	Repositorio Digital Pontificia Universidad Católica del Ecuador	67	740	295	205
6	352	Escuela Politécnica Nacional Repositorio Digital	356	753	261	162
7	464	Universidad Andina Simón Bolívar Repositorio Institucional	669	642	596	480
8	504	Repositorio Digital Universidad San Francisco de Quito	217	910	500	368
9	529	Repositorio Digital Universidad Central del Ecuador	149	944	435	438
10	791	Repositorio Digital Institucional de la Universidad Católica de Santiago de Guayaquil	884	1393	494	414
11	811	Repositorio Digital Universidad de las Américas	1156	1363	569	426
12	859	Repositorio Digital del Instituto de Altos Estudios Nacionales	553	1094	681	1014
13	900	Universidad Estatal de Milagro Repositorio	624	1351	676	795
14	994	Repositorio Institucional Universidad Técnica de Ambato	1114	1184	722	1161
15	1047	Repositorio de la Universidad Estatal Península de Santa Elena	1080	1584	771	729
16	1278	Repositorio Digital Universidad Laica Eloy Alfaro de Manabí	807	1441	1696	890
17	1300	Repositorio Universidad Técnica de Manabí	1675	1350	1300	1363
18	1461	Repositorio de la Universidad Tecnológica Equinoccial	130	860	222	2016

Figure 6.Webometrics Rankings (2016).

IV. DISCUSSION

Today there are many applications that are being developed for improving the semantic web, among which we can mention the semantic browser developed by Haystack at the Massachusetts Institute of Technology (MIT) [40]. It is the same that allows the user to personalize navigation according to their interests and tastes. It also has search engines that locate based vocabularies and based on conceptual graphs as Swoogle resources [41].

Question Answering over Linked Data (QALD) is used in works like [42] to understand or know those strengths, abilities and potential weaknesses in systems consultations sources of Linked Data and to make a comparison of how you can deal in handling a large amount of RDF data.

In [43] we can see that an assessment of compliance of the current suppliers of RDF data is done using the best practices of how to publish Linked Data on the Web. Comparing the Page Rank of each supplier and its linked data reaches the conclusion that providers with highly classified data are more likely to use RDF aside good practices of linked data, but they offer links to external domains.

It should be clear that the development of the semantic web has made a significant progress thanks to initiatives that promote change from the current web to the Web of Data having as deficiency of intelligent applications enabling us to exploit the semantics and provide a deeper data analysis. A Multidimensional Design Schema as proposed in [44] for creating tables of results based on RDF and/or OWL and use of tools On-Line Analytical Processing (OLAP) provide a new method of exploitation of information and analysis of information at a conceptual level.

In using the Drupal tool as a system content manager for the transformation of the web of UPSE to a semantic web, you can ensure a successful decision. Study centers such as the Escuela Superior Politecnica del Litoral (ESPOL) of Ecuador and Georgetong University in Qatar (GU-Q) both show different experiences in the use of this tool. While the ESPOL is able to exploit the tool for structuring information, use of taxonomy and ontology and improving usability, this strategy was reflected in improving its position in Webometrics by achieving the first place nationally in the Rankings of Universities. The GU-Q needed a flexible management system and a scalable content that could handle a large number of pages (over 2000), content types and levels of permissions, while providing flexibility for users and publishers alike.

However, both universities agree on the importance of integrating the web with different means of social communications to promote their products and services which results in a fully structured web and turn to be quite usable for their Internet users.

Following the results obtained and shown in the results section, the users of the UPSE web and the informatic systems used agree on the necessity to make strong future modifications in the structure and presentation of the information on the web in the future. Finally, changes were made to serve its content regardless of the syntactic structure. In the same way, it caters to different areas, taking into account all languages, while the procedures to add the semantic information so that, in this way, be understood by the officials responsible for processing. In addition, it takes into account the development and construction of the agents responsible for processing the information properly filter. This is quite useful for users or agents who have to perform a specific function. With all this, agents must retrieve and manipulate relevant information, which requires integration without breaking the web, but still take full advantage of existing infrastructures. Through this type of semantic web you can obtain solutions to common problems in finding information through the use of an infrastructure or common process by which it is possible to share, process and transfer information easily [18].

V. CONCLUSIONS

The implementation of a semantic wen in the Peninsula de Santa Elena University allows to know the lack in the information structure and the usability in its website. Through the changes made to the information on the website, we can say that today,this site shows different content and structure than the previously displayed one. This allows the user to be informed of what happens in the institution of higher education.

Today, the UPSE through the use of different informatics tools is counted as a website quietly usable, dynamic, intuitive and information structured to be easily accessed. In a short time, it has permitted improving the web ranking on the national and international with results shown by Webometrics. The creation of a semantic model adapted to the necessity of the UPSE assures generating structured contents that will be easily indexed by semantic search engines. Having an institutional digital repository gives you the opportunity to know each and every one of the activities that are documented and realized within the educational system; moreover of the field of research through files with easily accessible semantic descriptions.

The study and development of semantic web leaves a gap for the future development of intelligent applications that enable a better user experience on the internet.

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