

# Open access to educational resources in energy and sustainability: Usability evaluation prototype for repositories

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## ABSTRACT

The purpose of this paper is to show a PhD dissertation research plan, which aims to assess whether the users' experience of users to perform various tasks in an open access repository, increases by integrating Discovery Tools. The tasks to perform by the users are management and information design, dissemination and searches of open educational resources (OER) of sustainability energy. This research aims to develop a usability evaluation prototype which will offer new insights in the design of the information architecture. In the first stage, the criteria will be selected to measure the level of usability of the tasks to evaluate and develop the analysis of the current interactive design of the web repository. In the second stage, will consist of measure, once implemented the Discovery Tools in the web repository and check the usability level increase in relation with the criteria. In this paper you could find aspects as the motivations and the context in which it will develop this research, state of the art, hypothesis, research objectives, aspects of the methodology of the research, developed under the method of mixed layout, the current an expected contribution, the results and the validation and dissertation status. The results will contribute for detect new criteria and parameters for provide flexible interfaces, specifically for the web repositories, which are a part of the technological ecosystem of the scientific activity.

## Categories and Subject Descriptors

• **Human-centered computing~User centered design** • **Human-centered computing~Scientific visualization** • *Human-centered computing~Interface design prototyping*

## Keywords

Discovery tools; repository; usability evaluation prototype; design user interface; user centered design; user experience; science 2.0.

## 1. CONTEXT AND MOTIVATION THAT DRIVES THE DISSERTATION RESEARCH

In 2016, started the project "Binational Laboratory for the Intelligent Management of the Energy Sustainability and the Technological Formation" has been driven by the Tecnológico de Monterrey (México), the National Council for Science and Technology in México (CONACYT) and the Energy Ministry (SENER) [5]. This project aims to increase talent specialist in México on the topics of energy and sustainability with massive open access through MOOC courses which include open educational resources (OER) with topics of energy and sustainability; it provides the opportunity for professionals in the sector, access to educational platforms of open training independently and throughout life. The most characteristic features of MOOCs are massification, heterogeneity and the absence of a tutor, differ entirely from online academic training. [11]. A first approach to the study of the MOOC from its temporal evolution indicates, which since the first MOOC offering to society in 2008, until today, has been gaining importance in references in a way quite considerable and growing [14]. These new training practices, are aligned with the paradigms of the open movement that has the premise of sharing information not only with the communities that have difficulty to access upgrade resources and training but share their innovations with academic environments, governmental, institutional, with the intention to make available the use, production and dissemination of OER through Internet with freedom of use [32]. The term Open Educational Resources (OER) was coined at UNESCO's 2002 Forum on Open Courseware and designates "teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. There are two of ten recommends that States that involved this research are Support capacity building for the sustainable development of quality learning materials and Facilitate finding, retrieving and sharing of OER. [33]. [31] emphasizes that open access is an opportunity to improve the transfer and dissemination of knowledge and the repositories are recognized as a space for hosting and retrieve the scientific production and education.

In México, the Science and Technology's law, instructed to publish the results of the research financed with public funds, through open access platforms [8]. Within the technological trends of the MOOCs, is established to technology as a fundamental feature an adaptive system based on four components multicondition: LMS, Multiconditionals, Organizer 2.0 and an independent repository contents. [12]. In this regard, having a repository as a mechanism for the transfer of knowledge of open access, allows you to ensure the preservation and dissemination of the results of this project. Evaluate them processes related with them repositories, allows improve the experience of users

that are immersed in them different processes that it conform. To know them motivations and characteristics of those who seek information in an open repository, it could contribute to discover aspects that not be had considered and get new possibilities to enhance the experience of users in conjunction with the use of design methodologies focused on the needs of the potential users. With this purpose, this research aims to develop a usability evaluation prototype which will offer new insights in the design of the information architecture for repositories with Discovery Tools, considering best practices and standards for repositories to add new criteria that allow to use indicators to measure the user experience.

Based on the foregoing, the question arises of investigation of this study: What is the relationship that exists between the interface's usability of a repository with discovery tools and the experience of them users involved to the use it, in accordance with their characteristics and motivations?

## **2. STATE-OF-THE-ART**

Libraries are evolving to consolidate new platforms for access to information by the need to provide through a system of searches the catalog OPAC, databases of electronic resources of access closed and open access repositories. [3] Today it is possible to integrate an interface of smart search, which is known as discovery tools, these allow recover information quickly, quickly, from a single point of access and manage results of searches. [2] indicates that these also allow to them users discover the content of a library in all the formats, within the library physical or between their collections digital and them repositories. [4] evaluated fourteen Discovery Tools starting from sixteen criteria that are recognized as the features advanced of the catalogue of next generation and that allow valuing the adoption of a discovery tool. It is important to consider the integration of the characteristics of the discovery tools and the compatibility with the standards of the open access repositories concerning the information architecture to increase the management and visibility of the activity research. [15] exposed the need to integrate the scientific activity with web-based tools for social, science 2.0, which allow you to link people to share information, resources and documents with others. Therefore, it is not enough only to find usability also, should increase the use of technology for the dissemination of science.

It's essential to check, the interfaces that increase the user experience dramatically and determine the design of a prototype of usability to confirm the appropriate characteristics for each context. In accordance with [18] create or improve a product, service or system through the design principles of user experience design, it allows to offer clear and simple experiences based on decision-making, on its appearance, their functioning and their capabilities, information architecture and interactive design. Information architecture is the art of organizing information to improve the usability and give the facility users find what they are looking for [16]. The definition of interactive design by [19], has the purpose of that the design of the system or service responds to the actions that are offered to the users. [13] recommends that to close a cycle of management is go of the institution towards the people and again go of them people to the institution; so it should be considered the needs of all parties involved to achieve not only a greater user experience but to streamline strategic processes, content, information, data and knowledge.

The Discovery tools have been evaluated from studies that verify its characteristics from a comparative study, in contrast to the repositories have been established standards that consider aspects of interoperability, impact and visibility. The ISO-9241-11 [21], defined by usability the extent to which a product can be used by a group of users, to achieve specific objectives with effectiveness, efficiency and satisfaction in a context of use specified. [28] defines the experience of the user is based in rules that allow adjust the systems to them needs real of them users' potential. For [1] the evaluation of the usability, uses metrics to compare, to infer and do conclusions that reveal data and information on the characteristics and motivations that a user has to use a service or product and in addition the experience, behaviors and attitudes, to interact with the service or product. Usability inspection methods, such as heuristic evaluation, the cognitive walkthrough, formal usability inspections, and the pluralistic usability walkthrough, were introduced fifteen years ago. [20]. The heuristic evaluation method for evaluating user interfaces [25], involves having a small group of usability experts evaluate a user interface using a set of guidelines and noting the severity of each usability problem and where it exists. The cognitive walkthrough is a usability inspection method that evaluates the design of a user interface for its ease of exploratory learning, based on a cognitive model of learning and use [30]. Formal usability inspection is a review by the interface designer and his or her peers of users' potential task performance. Like the pluralistic usability walkthrough, this involves stepping through the user's task. However, because the reviewers consist of human factors experts, the review can be quicker, more thorough, and more technical than in the pluralistic walkthrough. The goal is to identify the maximum number of defects in the interface as efficiently as possible. The pluralistic usability walkthrough adapted the traditional usability walkthrough to incorporate representative users, product developers, members of the product team, and usability experts in the process. It is defined by five characteristics: 1. Inclusion of representative users, product developers, and human factors professionals; 2. The application's screens are presented in the same order as they would appear to the user; 3. All participants are asked to assume the role of the user; 4. Participants write down what actions they, as users, would take for each screen before the group discusses the screens; and 5. When discussing each screen, the representative users speak first [20]. [10] Although several taxonomies for classifying Usability inspection methods have been proposed, principally has been classified into two different types: empirical methods and inspection methods. Empirical methods are based on capturing and analyzing usage data from real end-users. Real end-users employ the software product (or a prototype) to complete a predefined set of tasks while the tester (human or specific software) records the outcomes of their work. [22] it mentions that it is not enough to make designs usable, but that it is essential to start to know the perception of users and check if the product or service is responding to their needs, placing the user in the center of the design processes and developing systems using user-centered design methodologies. OER usability evaluation has been evaluated under the IEEE LOM standards and classified according to their level of granularity and three principals' aspects: (1) the design of the interface, (2) the design of theoretical content and (3) navigation design. [26]

Know the characteristics and motivations of the users who will use the repositories and the implicit in scientific activity is a key point to address the selection of discovery tools for a repository.

## **3. HYPOTHESIS AND RESEARCH OBJECTIVES/GOALS**

This research proposes the following hypothesis of study:

Design a prototype usability of a repository with Discovery Tools that preserves educational resources of energy sustainability, increases the experience of users who are immersed in their processes.

Null hypothesis: Design a prototype usability of a repository with Discovery Tools that preserves educational resources of energy sustainability, does not increase the experience of the users who are immersed in their processes.

Research objective:

This paper aims at analyzing the usability of a web repository that integrates Discovery Tools, evaluating users' experience, and developing a prototype which will offer new insights in the design of the information architecture. Additionally, a versatile and user-friendly interface will be provided in an attempt to make the scientific knowledge created from the project entitled: "Binational Laboratory for the Intelligent Management of the Energy Sustainability and the Technological Formation" going open access.

The specific objectives are as follows:

- 1) To identify the criteria that allow to assess and select a discovery tools to integrate it into an open access repository, considering the standards and international metrics for open access repositories.
- 2) To do an information mapping architecture for the interactive design to determine the model of usability for different types of users that involve processes or activities within the repositories
- 3) To evaluate the prototype of the usability of the repository after you deploy Discovery Tools and make new contributions to implement it.

## **4. RESEARCH APPROACH AND METHODS, INCLUDING RELEVANT RATIONALE**

### **4.1 Research Method**

For the development of this research, we will use a mixed design method. [6] says that data, quantitative and qualitative to be based on their combined strengths to a better understanding of the research problem. [27] have found that the investigations carried out with the method of design mixed, have combined in a same stage of the research tools quantitative and qualitative in which their methods quantitative are used in a stage of the research and the qualitative in another.

Accordingly, this research will be approached under the design mixed model because the first stage, user experience design, will gather quantitative and qualitative data (competitive study of features of Discovery Tools, documentation of the repository and demographic surveys) and the second stage, also collect data quantitative and qualitative of the instruments of usability of the repository (survey, targeted focus groups and observation of patterns); the application of this method at the same time, provides equality in the status of the results.

### **4.2 Population and sample**

The study population we'll address are the librarians, researchers and participants of the courses of educational resources of energy sustainability of project production. The study sample will consist of around 15 participants, 5 by each type of profile, to detect the 100% of their problems (more important) in their different processes of each one (manager, depository and finder), and will be distributed in different moments of the process of development [19]. For your selection is used a sampling probability (approach quantitative) and in the approach qualitative the sampling will be intentional [6].

### **4.2 Study Variables**

- 1) Discovery Tools (DT): allow from a single interface to retrieve information and content of the repositories simultaneously with the records of library catalogs and collections of electronic resources available in the institution [24].
- 2) User's experience design (DCU): each repository should consider aspects such as: volume and growth, the use of metadata, internal organization, and the documentary type that store [23].
- 3) Evaluation of the usability (UX): the selection of a usability evaluation method depends on the resources required for the product ranging from a usability laboratory spaces for tests and specific technology, like video cameras and observation equipment [29].

### **4.3 Instruments and techniques**

- (1) Study competitive: analyze the functionalities of different Discovery Tools on the market.
- (2) Documentary research: Standards features and consistencies of the information architecture and interaction design of the repository. (Design of usability of the experience of the user).
- (3) Two surveys: issues demographic, technological, of needs and habits, competitive, of satisfaction, of preferences and of desires, types of profiles (researchers, librarians, authors of REA) (design of usability of the experience of the user and evaluation of the design's usability of the experience of the user).
- (4) Targeted focus groups: identifying the usability of the repository with Discovery Tools by user profiles (design of usability of the experience of the user and the user experience usability design evaluation).
- (5) Observation: to them profiles of user to the recover, manage or publish the information from the repository with the Discovery Tools to quantify the design, post the number of errors, measure the time that takes in perform the activity (evaluation of the design of usability of the experience of the user).

### **4.3 Information source**

- (1) Participants: researchers, librarians, and authors of REA.

(2) Appliances: 1 repository and Discovery Tools, (for open source and licensed).

(3) Digital material: articles from Scopus, books, e-books, videos and magazines that allow to know the State of the art of the variables involved in the study, as well as to compare and validate the results obtained.

#### 4.4 Data collection and analysis

First stage: (1) Competitive report on Google forms and Google docs of the Discovery Tools open and licensed access capabilities. (2) documentation of templates, diagrams, workflows and skeletons of design of the AI and DI of the repository (Visio, Project, Google docs, software for mockups and wireframes). (3) surveys: Identify the profiles of users and motivations (Google forms). (4) recording sessions of group sharing the experience and their motivations for the use of the repository, it captures information to text with Dragon Natural Speaking. With Nvivo. (5) analysis of the information to determine the Discovery Tool to use and produce a report with the main points.

#### 4.5 Data analysis

As regards the type of strategy for validation [7] recommended concurrent strategy of triangulation that seeks to confirm, correlate and corroborate the methods of information regarding the techniques used in relation to the measurable attributes of usability to determine the level of usability of searches and other features that has reached the repository to integrate it with the Discovery Tools and determine areas of opportunity that are [29]. Regarding the ethical aspects, they will be made arrangements between the participants to observe and get the information from the above-mentioned tools and protect the privacy of the participants involved.

#### 4.6 Data media and resource materials

(1) SPSS: software to develop statistical analysis. Project: Gantt diagrams.

(2) Google Docs: online reporting.

(3) Google Forms: studies comparative and checklist. Google Analytics: Develop analytical of the repository. Adobe XD: Mockups and Wireframes.

(4) Visio: Information flows.

(5) Recordings of sessions of Group: properly the and Dragon Natural Speaking. User-Zoom: analyze the behavior through a tool automated. Captivate: Screen recording.

(6) Repository: Workflows and information structure. Discovery Tools: features of next generation.

### 5. RESULTS TO DATE AND THEIR VALIDITY

The comparative study by [4] had the aim of help and upgrade to librarians about the latest news and user interfaces that require to consider adopting a tool of discovery (Discovery Tools); This will be used for reference for our study because it identifies sixteen criteria that were evaluated and compared the characteristics of fourteen discovery tools (three free and eleven graduates), while identifying if there are new features to incorporate them as new criteria to date. It is worth mentioning that the criteria mentioned in the study, are recognized as advanced features of the next generation "next generation catalog" catalog.

Although, [4] the Discovery Tools are constantly changing, but weighted in his study criteria focused on three factors that are, content coverage, the search capability, and its internal administration. For [9] it more important is contribute to increase the expectations of the experience of the user, in terms of speed, relevance and capacity of interact with the results obtained. [17] the goal is to achieve that the repositories are used increasingly by users and researchers from free-form to contribute to improve the visibility of the activity of scientific research in open access platforms.

Below, he is described in table 1 the criteria of evaluation used [4] and image 1 shows the results for each of the main tools of discovery.

**Table 1. List of criteria was used for the purpose of the evaluation.**

#	Criteria	Description
1	One-stop search for all library resources.	A discovery tool should include all library resources in its search including the catalog with books and videos, journal articles in databases, and local archives and digital repository. This can be accomplished by the unified index or federated search, an essential component for a discovery tool. Some of the discovery tools are described as web-scale because of their potential to search seamlessly across all library resources.
2	State-of-the-art web interface..	A discovery tool should have a modern design similar to e-commerce sites, such as Google, Netflix, and Amazon.

3	Enriched content	Discovery tools should include book cover images, reviews, and user driven input, such as comments, descriptions, ratings, and tag clouds. The enriched content can be either from library patrons, commercial sources, or both.
4	Faceted navigation.	Discovery tools should allow users to narrow down the search results by categories, also called facets. The commonly used facets include locations, publication dates, authors, formats, and more.
5	Simple keyword search box with a link to advanced search at the start page	A discovery tool should start with a simple keyword search box that looks like that of Google or Amazon. A link to the advanced search should be present.
6	Simple keyword search box on every page	The simple keyword search box should appear on every page of a discovery tool.
7	Relevancy	Relevancy results criteria should take into consideration circulation statistics and books with multiple copies. More frequently circulated books indicate popularity and usefulness, and they should be ranked higher on the top of the display. A book of multiple copies may also be an indication of importance
8	“Did you mean . . . ?” spell-checking	When an error appears in the search, the discovery tool should correct the query spelling as a link so that users can simply click on it to get the search results.
9	Recommendations/related materials	A discovery tool should recommend resources for readers in a similar manner to Amazon or other e-commerce sites, based on transaction logs. This should take the form of “readers who borrowed this item also borrowed the following . . .” or a link to recommended readings. It would be ideal if a discovery tool can recommend the most popular articles, a service similar to Ex Libris’ bX Usage-based Services.
10	User contribution	User input includes descriptions, summaries, reviews, criticism, comments, rating and ranking, and tagging or folksonomies.
11	RSS feeds	A modern OPAC should provide RSS feeds.
12	Integration with social networking	When a discovery tool is integrated with social networking sites, patrons can share links to library items with their friends on social networks like

	sites	Twitter, Facebook, and Delicious.
13	Persistent links.	Records in a discovery tool contain a stable URL capable of being copied and pasted and serving as a permanent link to that record. They are also called permanent URLs.
14	Auto-completion/ stemming	A discovery tool is equipped with the computational algorithm that it can auto-complete the search words or supply a list of previously used words or phrases for users to choose from. Google has stemming algorithms.
15	Mobile compatibility	There is a difference between being “mobile compatible” and a “custom mobile website.” The former indicates a website can be viewed or used on a mobile phone, and the later denotes a different version of the user interface specially built for mobile use. In this study we include both as “yes.”
16	Functional Requirements for Bibliographic Retrieval (FRBR).	The latest development of RDA certainly makes a discovery tool more desirable if it can display FRBR relationships. For instance, a discovery tool may display and link different versions, editions or formats of a work, what FRBR refers to as expressions and manifestations.

Criteria	Proprietary Discovery Tools											Free/Open source Discovery Tools		
	Aqua-Browser	Axiell-Arena	Biblio-commons	EBSCO/EDS	Endore	Endeca	Enterprise	Primo	Summon	Visualizer	Worldcat Local	Blacklight	Extensible/cataloging	Vu find
One-stop search for all library resources.	NO	NO	NO	YES	YES	NO	NO	YES	YES	NO	YES	NO	NO	NO
State-of-the-art web interface.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Enriched content	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Faceted navigation.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Simple key word search box with a link to advanced search at the start page	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Simple key word search box on every page	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES
Relevancy	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO
spell-checking "Did you mean . . . ?"	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES
Recommendations/related materials	NO	YES	YES	YES	YES	YES	NO	YES	YES	NO	YES	NO	YES	YES
User contribution	YES	YES	YES	YES	YES	NO	NO	YES	NO	NO	YES	NO	NO	YES
RSS feeds	YES	YES	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	YES
Integration with social networking sites	YES	YES	YES	YES	YES	YES	NO	YES	NO	NO	YES	NO	YES	NO
Persistent links.	YES	YES	NO	YES	NO	NO	NO	NO	NO	NO	YES	YES	NO	NO
Auto-completion/stemming	NO	YES	NO	NO	NO	YES	YES	YES	YES	NO	YES	NO	YES	NO
Mobile compatibility	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	NO	NO	YES
Functional Requirements for Bibliographic Retrieval (FRBR).	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES	NO
	11/16	13/16	10/16	12/16	11/16	11/16	7/16	14/16	11/16	7/16	14/16	6/16	9/16	10/16

Figure 1. Summary table comparison and evaluation

## 6. DISSERTATION STATUS

The thesis is in the first stage, which involves the analysis of the context of the repository and the documentation of the processes of management, storage and dissemination of the educational resources of energy sustainability. The theoretical framework of the first construct of this research, seeks to validate the criteria of evaluation of the Discovery Tools free or licensed and update them so that these features are integrated in the repository. It is essential that is placed in the current context of the features of the repository considering new trends in cataloging, information management, interoperability with the types of resources, standards, usability standards, mechanisms of storage and access, as well as protocols of connection with collectors regarding the motivations and characteristics of users looking for information on them.

To have items to add new components to the repository, whereas next generation interfaces, helps to increase the criteria and standards that allow rating its scalability. The evaluation of the experience of the user must be part of a process cyclic that allow that, in this case, them repositories continue evolving in relation to them trends avant-garde of treatment of information and the use of the technologies.

## 7. CURRENT AND EXPECTED CONTRIBUTIONS

With this research, it is helping to evaluate the Discovery Tools to be implemented in the library of the Tecnológico de Monterrey, allowing you to move forward in the proposal for the implementation of Discovery Tools for repository. Those results revolve around propose a prototype of the experience of user and provide the evaluation of usability of a repository with Discovery Tools that integrates resources open for it sustainability energy.

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## 9. REFERENCES

- [1] Albert, W., & Tullis, T. 2013. *Measuring the user experience: collecting, analyzing, and presenting usability metrics*. Newnes.
- [2] Alvite, M. 2012. Redefiniendo el catálogo: Expectativas de las interfaces de descubrimiento centradas en el usuario. *Investigación bibliotecológica*, 26(56), 181-204
- [3] Ávila, L., Ortiz, V., & Rodríguez, D. 2015. Herramientas de descubrimiento: ¿una ventanilla única? *Revista Española de Documentación Científica*, 38(1), e077.
- [4] Chickering, F. W., & Yang, S. Q. 2014. Evaluation and comparison of discovery tools: An update. *Information Technology and Libraries (Online)*, 33(2), 5.
- [5] Consejo Nacional de Ciencia y Tecnología. 2015. *Convocatoria CONACYT – Secretaría de Energía – Sustentabilidad Energética 2015 – 2016. Formación de recursos humanos especializados en materia de sustentabilidad energética*.
- [6] Creswell, J.W. 2015. *A concise introduction to mixed methods research*. Thousand Oaks, CA, USA: SAGE.
- [7] Creswell, J.W. 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (3 ed.)*. Thousand Oaks, CA, USA: SAGE.
- [8] Diario Oficial de la Federación. 2014. *Decreto por el que se reforman y adicionan diversas disposiciones de la Ley de Ciencia y Tecnología, de la Ley General de Educación y de la Ley Orgánica del Consejo Nacional de Ciencia y Tecnología*.
- [9] Fagan, J. C., Mandernach, M. A., Nelson, C. S., Paulo, J. R., & Saunders, G. 2012. Usability test results for a discovery tool in an academic library. *Information technology and libraries*, 31(1), 83-112.
- [10] Fernández, A., Insfran, E., & Abrahão, S. (2011). Usability evaluation methods for the web: A systematic mapping study. *Information and Software Technology*, 53, 789-817
- [11] Fidalgo-Blanco, Á., García-Peñalvo, F. & Sein-Echaluce, M. 2016. From massive access to cooperation: Lessons learned and proven results of a hybrid xMOOC/cMOOC pedagogical approach to MOOCs. *International Journal of Educational Technology in Higher Education (ETHE)*, 13(24). doi:10.1186/s41239-016-0024-z
- [12] Fidalgo Blanco, Á., García-Peñalvo, F., & Sein-Echaluce Lacleta, M. 2014. Tendencias en los MOOCs. Retrieved from <http://gredos.usal.es/jspui/handle/10366/125093>
- [13] García-Peñalvo, F. 2015. *Percepciones estratégicas de la Innovación Educativa*. Trabajo presentado en el 45 Congreso de Investigación y Desarrollo. Monterrey, México.
- [14] García-Peñalvo, F., Martínez Abad, F., & Rodríguez Conde, M. J. 2014. Evaluación del impacto del término "MOOC" vs "eLearning" en la literatura científica y de divulgación. *Profesorado. Revista de currículum y formación del profesorado*, 18(1), 185-201.
- [15] García-Peñalvo, F., García de Figuerola, C., & Merlo, J. 2010. Open knowledge: Challenges and facts. *Online Information Review*, 34(4), 520-539.
- [16] García, R., Botella, F., & Marcos, M. C. 2010. Hacia la arquitectura de la información 3.0: pasado, presente y futuro. *El profesional de la información*, 19(4), 339-347.
- [17] Glasserman M., & Ramírez-Montoya, M. S. 2015. Formación de investigadores educativos mediante el diseño de recursos educativos abiertos. *Revista de Investigación Educativa de la Escuela de Graduados en Educación*, 10(5), 36-42.
- [18] Garrett, J. J. 2010. *Elements of user experience, the: user-centered design for the web and beyond*. Pearson Education.
- [19] Hassan Montero, &, & Martín Fernández, F. 2004. Propuesta de adaptación de la metodología de diseño centrado en el usuario para el desarrollo de sitios web accesibles. *Revista española de Documentación Científica*, 27(3), 330-344.
- [20] Hollingsed T. & Novick, D. 2007. "Usability inspection methods after 15 years of research and practice". Proceedings of the 25th annual ACM international conference on Design of communication, 249-255.
- [21] International Standard ISO 9241-11:1998. 1998. *Ergonomic requirements for office work with visual display terminals (VDTs)*. Part 11: Guidance on usability.
- [22] Kalbach, J. 2007. *Designing web navigation*. O'Reilly Media, Inc.
- [23] Melero, R., Abadal, E., Abad, F., & Villarroya, A. 2015. Políticas institucionales para el fomento del acceso abierto: tipología y buenas prácticas. *Bollettino AIB*, 49(2) 159-170.

- [24] Merlo, J., Fernández, A., Ferreras, T., & Torre-Marín R. 2015. *Repositorios e integración de contenidos en herramientas de descubrimiento: la experiencia de la Universidad de Salamanca en Worldcat*. Trabajo presentado en las VI Jornadas de OS-Repositorios / XIV Workshop de REBIUN. Córdoba, España.
- [25] Molich, R., & Nielsen, J. 1990. Improving a human-computer dialogue. *Communications of the ACM* 33(3), 338-348
- [26] Morales, E., Gómez-Aguilar, D., & García-Peñalvo, F. 2008. HEODAR: Herramienta para la Evaluación de Objetos Didácticos de Aprendizaje Reutilizables. In J. Á. Velázquez-Iturbide, F. J. García-Peñalvo, & A. B. Gil (Eds.), *Actas del X Simposio Internacional de Informática Educativa - SIIIE'08 Salamanca*, España: Ediciones Universidad de Salamanca.
- [27] Onwuegbuzie J. & Leech, L. 2006. Linking Research Questions to Mixed Methods Data Analysis Procedures. *Qual Report; 11*(3), 474-498. Recuperado de <http://www.nova.edu/ssss/QR/QR11-3/onwuegbuzie.pdf>
- [28] Páez, A. H. 2016. Procedimiento de arquitectura de Información para los entornos de Realidad Virtual con fines educativos. *Serie Científica-Universidad de las Ciencias Informáticas*, 9(4).
- [29] Perurena, L., & Moráguez, M. 2013. Usabilidad de los sitios Web, los métodos y las técnicas para la evaluación. *Revista Cubana de Información en Ciencias de la Salud*, 24(2), 176-194.
- [30] Polson, P. G., Lewis, C., Rieman, J., & Wharton, C. 1992. Cognitive walkthroughs: a method for theory-based evaluation of user interfaces. *International Journal of man-machine studies*, 36(5), 741-773.
- [31] Ramírez-Montoya, M. S. 2015. Acceso abierto y su repercusión en la Sociedad del Conocimiento: Reflexiones de casos prácticos en Latinoamérica. *Education in the Knowledge Society (EKS)*, 16(1), 103-118. doi:<http://dx.doi.org/10.14201/eks2015161103118>
- [32] Ramírez-Montoya M. S., & García-Peñalvo, F. J. 2015. Movimiento Educativo Abierto. *Virtualis*, 6(12), 1-13.
- [33] UNESCO. 2012. 2012 Paris OER Declaration. Retrieved from [http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/Events/Paris%20OER%20Declaration\\_01.pdf](http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/Events/Paris%20OER%20Declaration_01.pdf)



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