Table of Contents

International Journal of Human Capital and Information Technology Professionals

Volume 9 • Issue 1 • January-March-2018 • ISSN: 1947-3478 • eISSN: 1947-3486
An official publication of the Information Resources Management Association

Research Articles

The *International Journal of Human Capital and Information Technology Professionals* is indexed or listed in the following: ACM Digital Library; Bacon's Media Directory; Cabell's Directories; DBLP; Google Scholar; INSPEC; JournalTOCs; MediaFinder; SCOPUS; The Standard Periodical Directory; Ulrich's Periodicals Directory; Web of Science; Web of Science Emerging Sources Citation Index (ESCI)

International Journal of Human Capital and Information Technology Professionals
Volume 9 • Issue 1 • January-March 2018

User Experience in Institutional Repositories:
A Systematic Literature Review

Laura Icela González-Pérez, Monterrey Institute of Technology and Higher Education, Monterrey, Mexico
María-Soledad Ramírez-Montoya, Monterrey Institute of Technology and Higher Education, Monterrey, Mexico
Francisco J. García-Peñalvo, University of Salamanca, Salamanca, Spain

ABSTRACT

Disruptive ideas and innovative business models take shape from observing and investigating the needs and demands of potential users and measuring their success based on the acceptance by users and their satisfaction. In an educational context, a new mission of the university has emerged, supported by the transfer of open access knowledge through Institutional Repositories (IR); it is important to know the motivations and needs of the academic community to promote scientific dissemination using these platforms. The present article uses the method of systematic literature review: using 29 studies from SCOPUS and WoS, involving the topics User-Centered Design (UCD) and repositories. The results show that two of the three UCD phases—evaluation and requirements—are closely linked and are the reiterative focus of UCD; thus, it is desirable to promote the design of custom-made prototypes according to the users' motivations. It is necessary to redefine methodologies for IR development within open-access ecosystems to guide them towards meeting their potential users' needs and motivations.

KEYWORDS

Context of Use, Evaluation, Open Access, Repositories, User Experience, User-Centered Design

1. INTRODUCTION

In an educational context, a new mission of the university has emerged, supported by the transfer of open access scientific knowledge through visualization platforms, such as the Massive Open Online Courses (MOOC) (Martínez Abad, Rodríguez Conde, and García-Peñalvo, 2014) and Institutional Repositories (García-Peñalvo et al., 2010); it is important, then, to know the motivations and needs of the academic community to promote scientific and academic dissemination using these platforms.

One of the most important platforms in the technological ecosystem of the open access movement is the Institutional Repository. However, to date, a repository's success has been measured from the perspective of software developers, and has neglected to measure user satisfaction and acceptance (Clements, Pawlowski & Manouselis, 2015). Two of the main challenges when implementing technological services in repositories are (a) visualization and discovery of information through the design of search interfaces that improve the retrieval of scientific and academic information (Gaona-Garcia, Martin-Moncunill and Montenegro-Marin, 2017) and (b) to develop prototypes that efficiently guide the objective for which they were created based on the users' needs and validating the

DOI: 10.4018/IJHCITP.2018010105

requirements through acceptance metrics and criteria that take into account users' needs (Meyerson, Galloway & Bias, 2012). By identifying the technological services and criteria required for the success of an Institutional Repository its use could increase significantly, and it would also be able to evolve according to new technology and information management trends.

The new business models of the 21st century integrate technology as an indispensable engine for them to incorporate into the digital market. Farwick, Schweda, Breu and Hanschke (2016) point out that the importance of strengthening the architectural model of information management and the design of processes applicable to a context lies on the fact that the capacities of modern companies depend on their information systems and the technological infrastructure that supports them. Therefore, universities should strive to search and participate in innovative and cutting-edge initiatives, and then generate disruptive innovation models to manage and provide visibility to their scientific and academic information worldwide.

It is essential to create prototypes of use and evaluation contexts for Institutional Repositories by seeking studies that have made contributions of evaluation and analysis of requirements. A systematic review of the literature carried out by Clements, Pawlowski and Manouselis (2016) is a significant contribution, in it they issued a recommendation to measure the success of Open Access Repositories, which can help developers, communities and future projects to design tools for the measurement of the success of a repository. The metrics they propose are:

1. People - Contributors and Users (Number of, growth, number of active, contribution frequency, contribution lifetime, collaborative edit);
2. Resources (Size, growth);
3. Interactions (Visits, Views, Downloads, Re-use, Contribution, Commenting, Collaborative contribution);
4. Repository lifetime.

Institutional repositories are embedded in at least four contexts of application: 1) technological services, which ensure the availability and security of information resources, 2) information architecture and design standards, 3) institutional and governmental regulations for open access dissemination and 4) metrics and evaluation criteria. In order to identify new opportunities to increase the adoption of Institutional Repositories by the academic community, the aim is to place the user at the center of the process and the developer as a facilitator and mediator in the redesign of new interfaces as a strategy to link the perspectives of both (Norman & Draper, 1986; Johnson, 1998). For this purpose, the User-Centered Design (UCD) methodology defined by Hassan-Montero and Ortega-Santamaría (2009) will be used as a cyclical process focused on a product meeting the needs of its users.

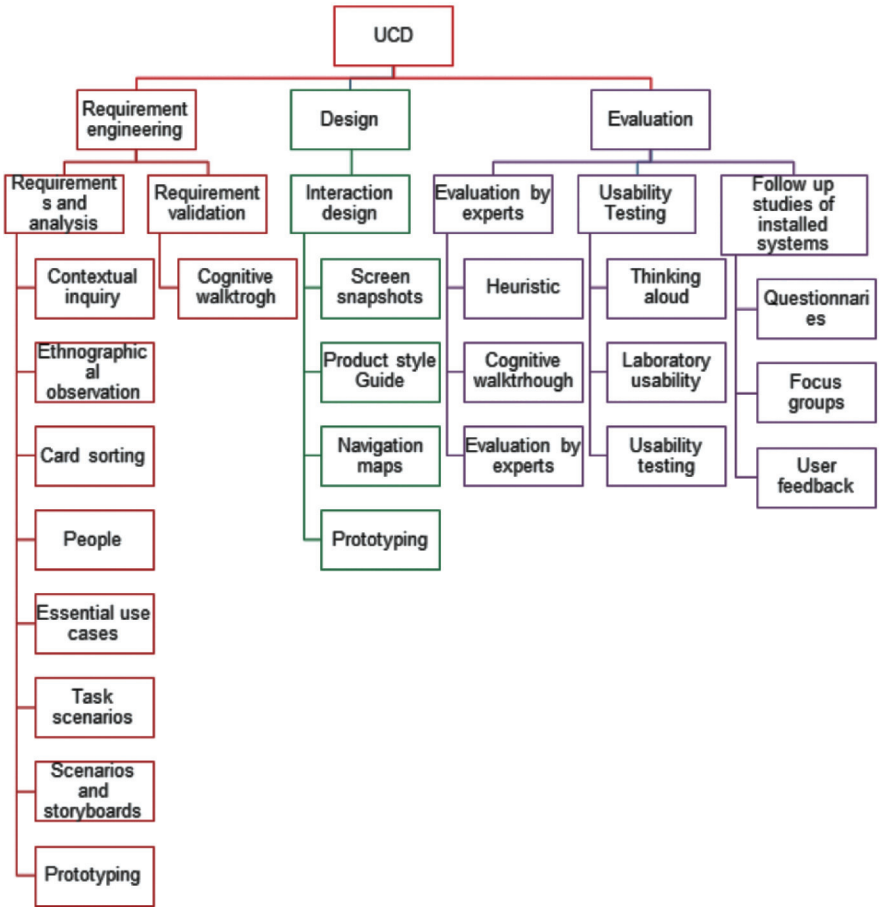
The ISO 13407 standard defines the UCD as a guideline to describe the users and environments of a software system, and breaks it down into four phases:

1. **Context of use:** People the product is aimed at, what will it be used for and under which conditions;
2. **Requirements:** Objectives the product should meet;
3. **Design:** Conceptual and design solution;
4. **Evaluation:** Validation of the requirements and detection of usability problems through user tests, highlighting the importance of integrating both standards so they can complement each other.

The study by Magües, Castro and Acuna (2016) presents a review of 31 studies, articles and conferences to know the state of the integration of user-centered design techniques in the development of systems and propose a framework based on the phases and techniques used for each technique (see Figure 1).

The present work searched studies published around the world covering some of the UCD phases and techniques used to develop, implement or design repositories. The objective is to identify

Figure 1. UCD phases and techniques defined by Magües, Castro, and Acuna (2016)

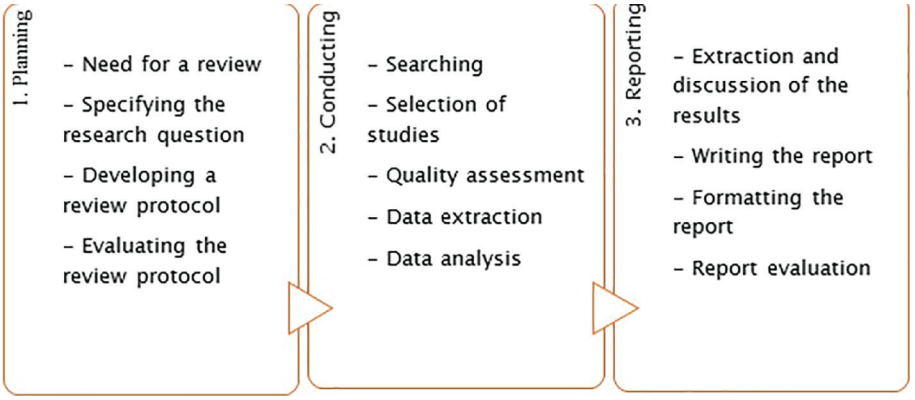


the manner in which the integration was carried out, as well as the results, in order to systematize information and create a best practices framework when implementing Institutional Repositories. In light of this, the following research question arises: What are the UCD phases and techniques used in the context of repositories?

2. METHODOLOGY OF SYSTEMATIZATION OF STUDIES

Nowadays, with the massive increase of information on the internet, it is necessary to employ strategies to select information that could ensure its quality and relevance. García-Peñalvo (2017) points out that literature mapping allows for the identification, evaluation, and interpretation of a number of studies available and collected from a specific period, covering a topic or phenomenon of interest, and also facilitates the extraction of relevant information to know the results and research methods used. For this study, the relevant topic is UCD applied to repositories, as it is necessary to know what the background and results are when implementing UCD in repositories. The first method used was the systematic literature review under the software engineering guidelines established by Debe ser Keele (2007), which are composed of three phases: (I) planning, (II) conducting, and (III) reporting. Figure 2 shows the phases and their corresponding tasks.

Figure 2. SLR phases by Kitchenham and Charters (2007)



To systematize the SLR phases, the studies were systematized according to the SLR proposed by Schön et al., (2017). The Excel software was used to manage the records of the studies, and progress was tracked using a spreadsheet to organize the relevant studies according to the phases.

2.1. Planning

2.1.1. Need for a Review

Our goal was to find research that had the objective of integrating at least one of the UCD phases in the context of repositories and analyze the results to establish and develop a framework of best practices to design and evaluate Institutional Repositories through UCD.

Search queries were conducted on the SCOPUS and WEB of Science databases for: Systematic Literature Review AND (Repositories OR Repository OR "library information science") AND "user centered design". However, no research was found on the topic.

2.1.2. Specifying the Research Question

RQ1: What are the UCD phases and techniques used in the context of repositories?

By identifying how UCD phases and techniques have been used in repositories, access is gained to a series of strategies for academic communities to apply to their own contexts and advance at a faster pace, avoiding risks and saving time finding resources. Using this systematized information, best practices can be identified to develop reference guidelines for repositories, and can be used also to identify results for recommendations and considerations once applied to practice.

2.1.3 Developing A Review Protocol

This literature mapping seeks to showcase the UCD phases and techniques used in repositories.

To categorize the phase and technique used on each of the 29 studies, we used the phases and techniques discussed by Magües, Castro and Acuna in 2016 as a framework.

2.2. Conducting

The main objectives of this stage were to retrieve, select and analyze the primary information resources found in the databases, according to the following activities.

2.2.1. Search Strategies and Resources

To determine the keywords that would answer the RQ1 and RQ2 research questions, we used global keywords. Next, we identified synonyms. After that, we defined a combination of keywords and performed a test search in the database, and then we defined the keywords with Boolean operators (see Table 1).

The search query was connected using the Boolean operators AND and OR, structured in the following manner:

("user centered design") AND (repositories OR repository OR "library information science")

The inclusion criteria of the databases in which the search query was made were established based on the quality of the resources found relevant since they were accepted in publications with a high level of impact due to the relevance and content of the studies and authors who are accepted and recognized in the field. The search spaces for each criterion are shown in Table 2.

2.2.2. Selection of Studies

While conducting the search queries in the selected databases according to the inclusion and exclusion criteria, the results were exported to an Excel compatible format, up until the final results are stored and the analysis of the abstract of each study can begin to validate that the topic is actually covered (see Figure 3). The final results of the study by document type is shown in Table 3.

2.2.3. Quality Assessment

Using a check list for each of the questions, we evaluated whether the research can answer the question from the contents of the abstract.

2.2.4. Data Extraction and Analysis

When refining the search query, 29 studies were found: 10 articles, 1 book chapter, and 18 conferences. The abstract of each study was inspected to select only those meeting the quality criteria shown in Table 4 and related to UCD and repositories, ensuring the reliability and validity of the study. The results can be found in Table 5.

According to Kitchenham and Charters, data extraction can be carried out using specialized software that supports data extraction and organization using metadata, such as title, authors, year, publication, abstract, doi, affiliation and number of pages. See DB https://goo.gl/QBWDsC

Table 1. Keywords used in the search query

Category	Keywords
Repositories	*repository, repositories, "library information science"*
User-centered design	*"user centered design"*

Table 2. Search spaces and inclusion and exclusion criteria

Database	Search Strategy	Date of Search	Document Type	Language
SCOPUS	Abstract, title, keywords	2009 - 22/08/2017	Articles, Conference, Chapters book	English
Web of science	Topic	2009 22/08/2017	Proceedings paper, article, book chapter	English

Figure 3. Process of selection of studies

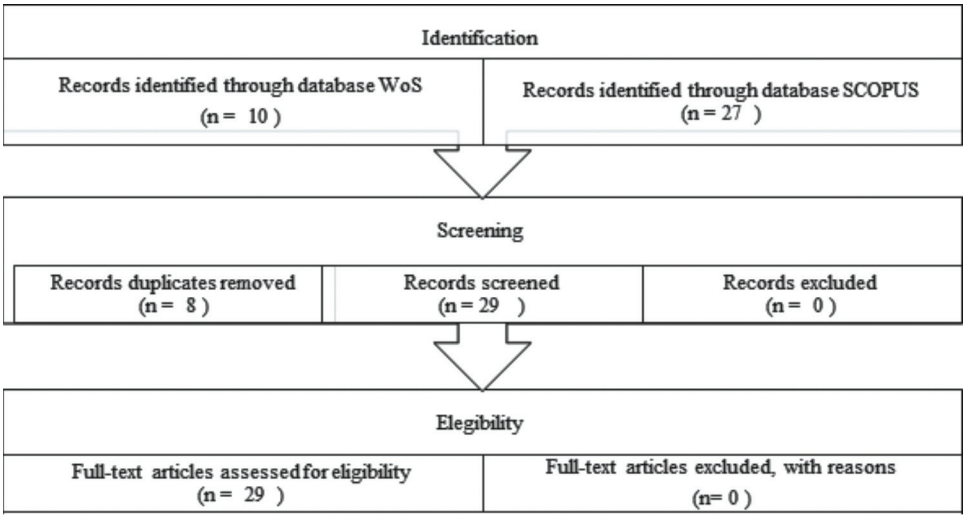


Table 3. Final results of the studies by document type

	1st Search Results			Eliminated			Final Results		
Keyword	WoS	Scopus	Subtotal	Duplicates (removed from WOS)	Outside the scope	Total	Articles	Proceeding	Chapters
"user centered design" AND (repositories OR repository)	10	27	37	8	0	29	10	18	1

Table 4. Quality Criteria

Item	Assessment criteria	Score	
AC1	Mentions the study used the UCD approach	-1 0 1	No Partially Yes
AC2	Describes the phase used in the study	-1 0 1	No Partially Yes
AC3	Describes the technique used in the study	-1 0 1	No Partially Yes
AC4	Includes the results, providing recommendations once the study concluded	-1 0 1	No Partially, unclear Yes

Table 5. Study code and reference

Code	Reference
S1	Alkalai, L., Derewa, C. S., Srivastava, P., Karlsson, D., & Huang, C. (2016). LAUNCH: User experience design of the innovation to flight portal. *Paper presented at the International Astronautical Congress*.
S2	Al-Muhanna, H., Al-Wabil, R., Al-Mazrua, H., Al-Fadhel, N., & Al-Wabil, A. (2011). An interactive multimedia system for monitoring the progressive decline of memory in Alzheimer's patients. In *Proceedings of the International Conference on Human-Computer Interaction, CCIS* (Vol. *174,* pp. 382-385). Springer Verlag. doi:10.1007/978-3-642-22095-1_77
S3	Chacón-Pérez, J., Hernández-Leo, D., Mor, Y., & Asensio-Pérez, J. I. (2016). User-centered design: supporting learning designs' versioning in a community platform. In *The Future of Ubiquitous Learning* (pp. 153-170). Springer Berlin Heidelberg.
S4	Dalrymple, O. O., Bansal, S. K., & Gaffar, A. (2014). User research for the instructional module development (IMOD TM) system. In 121st ASEE Annual Conference and Exposition: 360 Degrees of Engineering Education. American Society for Engineering Education.
S5	De Matos, P., Cham, J. A., Cao, H., Alcántara, R., Rowland, F., Lopez, R., & Steinbeck, C. (2013). The Enzyme Portal: a case study in applying user-centred design methods in bioinformatics. *BMC bioinformatics, 14*(1), 103.
S6	Ferran, N., Guerrero-Roldán, A. E., Mor, E., & Minguillón, J. (2009, July). User centered design of a learning object repository. In *Proceedings of the International Conference on Human Centered Design* (pp. 679-688). Springer, Berlin, Heidelberg.
S7	Godbold, N. (2009). User-Centred Design vs. "Good" Data Base Design Principles: a Case Study, Creating Knowledge Repositories for Indigenous Australians. *Australian Academic & Research Libraries*, *40*(2), 116-131.
S8	González Pérez, L. I., Ramírez-Montoya, M. S., & García-Peñalvo, F. J. (2016). Open access to educational resources in energy and sustainability: Usability evaluation prototype for repositories. In *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 1103-1108). ACM.
S9	Hüttig, A., & Herczeg, M. (2015). Tool-based gradual user modeling for usability engineering. In *Proceedings of the European Conference on Cognitive Ergonomics 2015* (p. 11). ACM.
S10	Hüttig, A., & Herczeg, M. (2016). Tool-Supported Usability Engineering for Continuous User Analysis. In *Proceedings of the International Conference on Human-Computer Interaction* (pp. 302-312). Springer International Publishing.
S11	Kim, Y. S., Noh, J. H., & Kim, S. R. (2013). A case study for application of design for affordance methodology using affordance feature repositories. In *Proceedings of the 19th International Conference on Engineering Design (ICED13) Design For Harmonies*, Vol. 5: Design for X, Design to X, Seoul, Korea. 2013.
S12	Kim, Y. S., Hong, Y. K., Kim, S. R., & Noh, J. H. (2013). User activity analysis for design for affordance. In *Proceedings of the 19th International Conference on Engineering Design (ICED13) Design For Harmonies*, Vol. 5: Design for X, Design to X, Seoul, Korea 19-22.08. 2013.
S13	Kumaraguru, P., Cranor, L. F., & Mather, L. (2009). Anti-phishing landing page: Turning a 404 into a teachable moment for end users. In *Proceedings of the Conference on Email and Anti-Spam (CEAS)*.
S14	Leinonen, T., Purma, J., Poldoja, H., & Toikkanen, T. (2010). Information architecture and design solutions scaffolding authoring of open educational resources. *IEEE Transactions on Learning Technologies, 3*(2), 116-128.
S15	Macías, J. A. (2012). Enhancing interaction design on the semantic web: A case study. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, *42*(6), 1365-1373.
S16	McGee-Lennon, M. R., Ramsay, A., McGookin, D., & Gray, P. (2009). User evaluation of OIDE: a rapid prototyping platform for multimodal interaction. In *Proceedings of the 1st ACM SIGCHI symposium on Engineering interactive computing systems,* 237-242. ACM.
S17	Mentler, T., & Herczeg, M. (2015). Flexible Tool Support for Collaborative Design of Interactive Human-Machine Systems. In *Proceedings of the European Conference on Cognitive Ergonomics 2015*. ACM.
S18	Meyerson, J., Galloway, P., & Bias, R. (2012). Improving the user experience of professional researchers: Applying a user-centered design framework in archival repositories. In *Proceedings of the American Society for Information Science and Technology, 49*(1), 1-7.
S19	Moghnieh, A., Sayago, S., Arroyo, E., Sopi, G., & Blat, J. (2009). Parameterized user-centered design for interacting with multimedia repositories. In *Proceedings of the First International Conference on Advances in Multimedia MMEDIA'09* (pp. 130-135). IEEE.
S20	Pandey, S., & Srivastava, S. (2014). Data Driven Enterprise UX: A Case Study of Enterprise Management Systems. *In International Conference on Human Interface and the Management of Information* (205-216). Springer International Publishing.
S21	Plazzotta, F., Mayan, J. C., Storani, F. D., Ortiz, J. M., Lopez, G. E., Gimenez, G. M., & Luna, D. R. (2015). Multimedia health records: User-centered design approach for a multimedia uploading service. *Studies in Health Technology and Informatics* (Vol. 210, pp. 474-478). doi:10.3233/978-1-61499-512-8-474
S22	Power, C., Lewis, A., Petrie, H., Green, K., Richards, J., Eramian, M., & Rijke, M. D. (2017). Improving Archaeologists' Online Archive Experiences Through User-Centred Design. *Journal on Computing and Cultural Heritage (JOCCH), 10*(1), 3.

continued on following page

Table 5. Continued

Code	Reference
S23	Ribeiro, I. (2012). Quantitative Evaluation of Educational Websites. In *Proceedings of the 6th International Conference of Technology, Education and Development (INTED)*, Valencia, Spain (pp. 3448-3457).
S24	Sands, A., Borgman, C. L., Wynholds, L., & Traweek, S. (2012). Follow the data: How astronomers use and reuse data. *Proceedings of the American Society for Information Science and Technology, 49*(1).
S25	Solano, A., Masip, L., Granollers, T., Collazos, C. A., Rusu, C., & Arciniegas, J. L. (2013). Setting usability iTV heuristics in Open-HEREDEUX. In *Human Computer Interaction* (pp. 55-58). Springer International Publishing.
S26	Toikkanen, T., Purma, J., & Leinonen, T. (2010*).* LeMill: A case for user-centered design and simplicity in OER repositories. Free and Open Source Software for E-Learning: Issues, Successes and Challenges: Issues, Successes and Challenges.
S27	Toure, C. E., Michel, C., & Marty, J. C. (2015). Refinement of Knowledge Sharing Platforms to promote effective use: A use case. In *Proceedings of the 2015 11th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS)* (pp. 680-686). IEEE.
S28	Wynholds, L., Fearon Jr, D. S., Borgman, C. L., & Traweek, S. (2011). When use cases are not useful: Data practices, astronomy, and digital libraries. In *Proceedings of the 11th annual international ACM/IEEE joint conference on Digital libraries* (pp. 383-386). ACM.
S29	Xie, J. (2009). Sustaining quality assessment processes in user-centred health information portals. In *Proceedings of AMCIS 2009* (p. 189).

2.3. Reporting

To draft the report, the authors' APA references were matched to an alphanumeric code in alphabetic order to identify the studies included in the report. The classification of the authors and the scores is shown in Table 7.

2.3.1. Quality Criteria Report

We identified the quality assessment criteria shown in Table 4 on each of the 29 studies found. The results can be found on Table 6, and the representation in Figure 4.

2.3.2. Report of Type of Study and Study by Country

Based on the inclusion and exclusion criteria, 11 articles, 1 book chapter and 17 proceedings were found on the selected databases and were evaluated using the quality criteria. They were analyzed to identify the year, type of publication and name of journal or conferences in which they appeared, in order to find where these studies are being published (see Tables 8, 9 and 10 and Figure 5).

2.3.3. Report of the Answers to the Research Questions

To answer the question:

From the perspective of Magües, Castro and Acuna (2016), the UCD approach focuses on three stages, (1) requirements, (2) design and (3) evaluation, and for each stage it is recommended to use certain techniques to collect, establish and evaluate the design of products and services. Below we present the report of the answers to RQ1A – What are the UCD phases and techniques used in the context of repositories? made from the analysis of the UCD phases and techniques used in each of the 29 studies found.

Table 6. Results of the quality criteria

# of Criteria	Total Percentage of Studies	# of studies	Study Code
4 quality criteria	41.5%	12	S1, S5, S6, S7, S9, S21, S13, S17, S18, S19, S25, S27
3 quality criteria	41.5%	12	S2, S3, S4, S10, S11, S12, S14, S20, S23, S24, S26
2 quality criteria	17.5%	5	S8, S15, S16, S22, S28

Table 7. Classification of authors and scores

	AC1	AC2	AC3	AC4	Total
S1-	1	1	1	1	4
S2-	1	0	1	1	3
S3-	0	1	1	1	3
S4-	1	1	0	1	3
S5-	1	0	1	1	3
S6-	1	1	1	1	4
S7-	1	0	1	1	3
S8-	0	1	1	0	2
S9-	1	1	0	1	3
S10-	0	0	1	1	2
S11 –	0	1	1	1	3
S12-	0	1	1	1	3
S13-	1	1	1	1	4
S14-	0	1	1	1	3
S15-	0	0	1	1	2
S16-	0	0	1	1	2
S17-	1	1	1	1	4
S18-	1	1	1	1	4
S19-	1	1	1	1	4
S20-	0	1	1	1	3
S21 -	1	1	0	1	3
S22 -	0	0	1	1	2
S23 -	0	1	1	1	3
S24 -	0	1	1	1	3
S25 -	1	1	1	1	4
S26 -	0	1	1	1	3
S27 -	1	1	1	1	4
S28 -	0	0	1	1	2
S29 -	1	0	1	1	3
	15	19	26	21	81

The analysis of the 29 studies found 5 studies covering the requirements phase, 12 covering the design phase and 13 focused on evaluation (see Table 11).

The techniques used in each study are described in the report below, based on the phase of each study.

2.4. Requirements Phase

The studies identified in the requirements phase focus on the use of techniques that seek to analyze the context in which the system is used and determine the user's profile. To describe the users of the repository, S1 employs the techniques of "People", "Task flows", "Mock-ups", "Rapid prototyping",

Figure 4. Representation of the quality criteria results

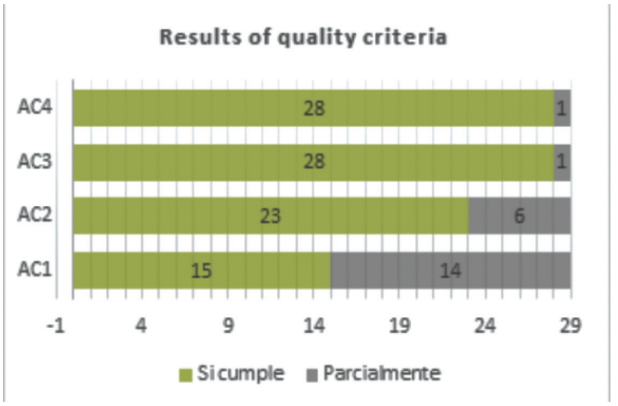
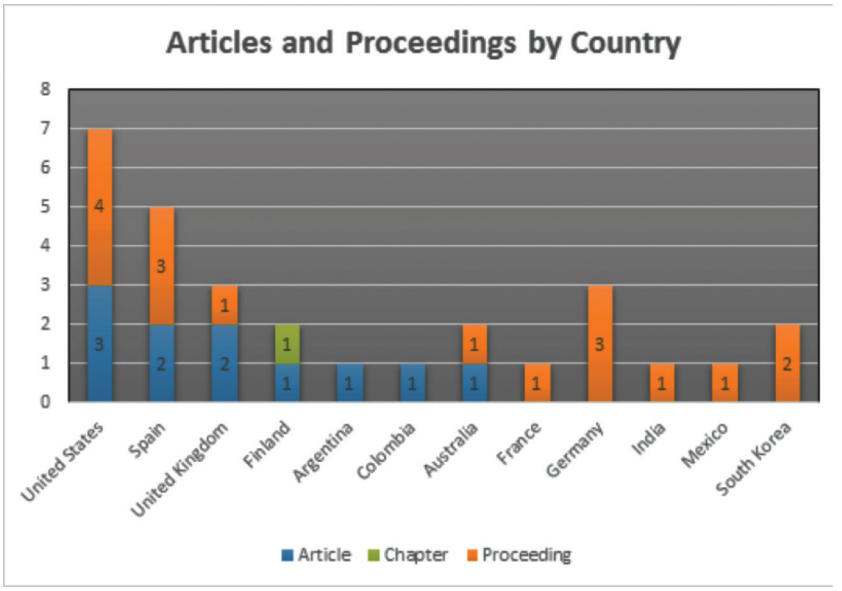


Figure 5. Representation of the quality criteria results



and "Continuous iteration on design and development", and validates each step, including user participation. S10 makes a contribution in the area of user analysis and develops a module to support this important aspect of software development within its Usability Engineering Repository (UsER) system; as a counterpart, S24 focused on performing an analysis to design surveys that evaluated infrastructure, work divisions, knowledge and experience of personnel regarding the proper care of data in the astronomy field. S6 considers that, in order to integrate repositories of learning objects in virtual learning environments and for them to be useful, a complete analysis of users' informational behavior is required when they access, treat, integrate, evaluate, create and communicate information for the purpose of learning.

Table 8. Articles found

Study Code	Year	Author	Source	Country
S22	2017	Power, C., Lewis, A., Petrie, H., Green, K., Richards, J., Eramian, M., & Rijke, M. D	Journal on Computing and Cultural Heritage	United Kingdom
S3	2016	Chacón-Pérez, J., Hernández-Leo, D., Mor, Y., & Asensio-Pérez, J. I.	Future of ubiquitous learning: learning designs for emerging pedagogies	Spain
S21	2015	Plazzotta, F., Mayan, J. C., Storani, F. D., Ortiz, J. M., Lopez, G. E., Gimenez, G. M., & Luna, D. R.	Studies in Health Technology and Informatics	Argentina
S5	2013	De Matos, P., Cham, J. A., Cao, H., Alcántara, R., Rowland, F., Lopez, R., & Steinbeck, C	BMC Bioinformatics	United Kingdom
S25	2013	Solano, A., Masip, L., Granollers, T., Collazos, C. A., Rusu, C., & Arciniegas, J. L.	Human Computer Interaction	Colombia
S15	2012	Macías, J. A.	IEEE Transactions on Systems, Man and Cybernetics Part C: Applications and Reviews	Spain
S18	2012	Meyerson, J., Galloway, P., & Bias, R	Proceedings of the ASIST Annual Meeting	United States
S24	2012	Sands, A., Borgman, C. L., Wynholds, L., & Traweek, S.	Proceedings of the ASIST Annual Meeting	United Sates
S2	2011	Al-Muhanna, H., Al-Wabil, R., Al-Mazrua, H., Al-Fadhel, N., & Al-Wabil	Communications in Computer and Information Science	United Sates
S14	2010	Leinonen, T., Purma, J., Poldoja, H., & Toikkanen, T.	IEEE Transactions on Learning Technologies	Finland
S7	2009	Godbold, N. (2009).	Australian Academic and Research Libraries	Australia

Table 9. Book chapters found

Study Code	Year	Author	Source	Country
S26	2010	Toikkanen, T., Purma, J., & Leinonen, T.	Free and Open Source Software for E-Learning: Issues, Successes and Challenges	Finland

2.5. Design Phase

For the design phase, S11 identifies affordances and functionalities as the most important elements when designing a repository, while for S22 the importance lies in the ability of its users to retrieve satisfactorily the contents through a search system, highlighting the need to improve the quality of repositories' metadata. The authors of S26 recognize that, faced with the design of a repository, a first stage of long reach diffusion is required, and a first step to achieving that is a training process for the teachers about its usefulness, so once they begin to use the service the patterns of behavior

Table 10. Proceedings found

Study Code	Year	Author	Source	Country
S1	2016	Alkalai, L., Derewa, C. S., Srivastava, P., Karlsson, D., & Huang, C	Proceedings of the International Astronautical Congress, IAC	United States
S8	2016	González Pérez, L. I., Ramírez-Montoya, M. S., & García-Peñalvo, F. J.	ACM International Conference Proceeding Series	Mexico
S10	2016	Hüttig, A., & Herczeg, M. (2016)	International Conference on Human Interface and the Management of Information	Germany
S27	2016	Toure, C. E., Michel, C., & Marty, J. C.	Proceedings - 11th International Conference on Signal-Image Technology and Internet-Based Systems, SITIS 2015	France
S4	2014	Dalrymple, O. O., Bansal, S. K., & Gaffar, A.	ASEE Annual Conference and Exposition, Conference Proceedings	United States
S9	2015	Hüttig, A., & Herczeg, M.	ACM International Conference Proceeding Series	Germany
S17	2015	Mentler, T., & Herczeg, M.	ACM International Conference Proceeding Series	Germany
S20	2014	Pandey, S., & Srivastava, S.	International Conference on Human Interface and the Management of Information	India
S11	2013	Kim, Y. S., Noh, J. H., & Kim, S. R.	Proceedings of the International Conference on Engineering Design, ICED	South Korea
S12	2013	Kim, Y. S., Hong, Y. K., Kim, S. R., & Noh, J. H.	Proceedings of the International Conference on Engineering Design, ICED	South Korea
S23	2012	Ribeiro, I.	INTED2012: International Technology, Education and Development Conference	Spain
S28	2011	Wynholds, L., Fearon Jr, D. S., Borgman, C. L., & Traweek, S.	Proceedings of the ACM/IEEE Joint Conference on Digital Libraries	United States
S6	2009	Ferran, N., Guerrero-Roldán, A. E., Mor, E., & Minguillón, J.	International Conference on Human Centered Design	Spain
S16	2009	McGee-Lennon, M. R., Ramsay, A., McGookin, D., & Gray, P.	EICS'09 - Proceedings of the ACM SIGCHI Symposium on Engineering Interactive Computing Systems	United Kingdom
S13	2009	Kumaraguru, P., Cranor, L. F., & Mather, L.	6th Conference on Email and Anti-Spam, CEAS 2009	United States
S19	2009	Moghnieh, A., Sayago, S., Arroyo, E., Sopi, G., & Blat, J.	Proceedings - 2009 1st International Conference on Advances in Multimedia, MMEDIA 2009	Spain
S29	2009	Xie, J.	15th Americas Conference on Information Systems 2009, AMCIS 2009	Australia

Table 11. UCD phases and techniques identified in 29 studies

Phases and Techniques	# Studies	Studies
Requirements	**5**	
Cognitive Walkthrough	2	S13, S6
Questionnaires	2	S24, S5
Scenario based approaches	1	S10
Design	**12**	
Questionnaire	1	S27
Conceptual design	3	S22, S26, S28
Design features	1	S11
Interaction design and information architecture	2	S14, S20
People, card sorting, user workflows	1	S5, S1
Prototyping	3	S1, S16, S19, S29
Unspecified	1	S21
Evaluation	**13**	
Evaluation	3	S12, S15, S2
Expert evaluation	1	S9
Quantitative evaluation	1	S23
Questionnaires	1	S17
Usability evaluation	2	S25, S8
Usability testing	2	S18, S7, S5
User feedback	2	S3, S4

and the real needs of teachers can appear, and that is when evaluation based on feedback must be used to improve the service to custom-tailor it to its users.

2.6. Evaluation Phase

The evaluation phase of UCD and the requirements are closely linked because UCD is a cyclical process that begins with the requirements and ends with the evaluation, but continues to make changes using the results of the evaluation, which then become new requirements. For the authors of S12, when navigating a data system not only the presentation is important, but also the semantic model used, so in their study they provide an evaluation of the interaction. The purpose of the S9 study was to create a module within a Usability-Engineering-Repository (UsER) Design System, which consists of an innovative concept of gradual user modeling with several levels of abstraction that guide and simplify the user's practical modeling process. The design of the module was validated with the help of expert evaluation. S23 proposes a method of quantitative evaluation of educational websites to know the quality criteria that satisfy users, from the design of their interface, to the content and the functionalities offered to interact with their users. Websites should allow easy, pleasant and efficient access to the information and services they provide. S17 proposes modules of analysis and design for the different stages of software engineering, which manages to create a semantic network when analyzing the context of use through the design and up until the summative evaluation of the product. S25 describes the process that was carried out to come up with a set of heuristics for the

Open Repository of the Open-HEREDEUX. S8 is developing research to establish criteria to measure the level of usability of tasks to evaluate a repository. S18 proposes a UCD framework based on the design of user experience and usability to improve the experience of researchers when consulting archive services. S3 includes a proposal to make creative modifications and refinements to the system based on reviews extracted from various feedback sources (from students, other educators, self-assessments) and specific issues derived from contextual needs in their information system. S4 addresses the need to identify gaps in user interactions with the tools they use to obtain a consensus view of the assessment of a representation of the required knowledge (learning taxonomies, support data, and pedagogical and evaluation strategies).

More innovative studies, focusing on semi-automatic tools and intelligent systems, were S29, which proposes a semi-automated, user-centered quality assessment approach, supported by indicators and a decision support tool. S20 mentions the need to consolidate mapping between user and system relationships that allows the designer to create an information architecture and to correlate the mental construction of the system in the user's mind. It also argues that in the era of mass information it is imperative to systematize well-defined data sets with visible relationships to create a valuable information repository for the designer to make decisions regarding optimization of tasks and the creation of business intelligence in the system itself. S20's authors mention the advantages and methods of 'consuming' the user interface to increase user productivity and reduce the learning curve. S14 presents the information architecture and design of the Lemill Repository, includes technical solutions and considers design to be a very important contribution to the creation of Open Educational Resource Ecosystems.

3. CONCLUSION

Institutional Repositories are based on technological platforms that support the digital contents of the scientific production of Universities and Research Centers, and it is necessary to identify new strategies to guide them toward the innovation of new services and functionalities of technology trends, as well as to avoid their obsolescence and ensure the satisfaction of the academic communities based on their usefulness, experience and usability (González-Pérez, Ramírez-Montoya and García-Peñalvo, 2016). UCD is a methodology that allows identifying the needs of users to design proposals based on available research, and for those proposals to be evaluated and validated by the user. Although Clements, Pawlowski and Manouselis (2015) propose to evaluate the satisfaction and acceptance of the users of a Repository, they do not indicate that a complete analysis of the informational behavior of its users should be carried out first (Ferran, Guerrero-Roldán, Mor and Minguillón, 2009) and to identify deficiencies in user interactions, in this case within the Repository (Dalrymple, Bansal and Gaffar, 2014). A technology adoption model establishes the importance and the degree of maturity between the offered product and its users, so this phase is highlighted as the one that contains relevant information about the usefulness of products or services.

There are two challenges when designing and choosing the best technologies for repositories. The first is the repository's search interface (Gaona-Garcia, Martin-Moncunill & Montenegro-Marin, 2017), which coincides with the research of Power, Lewis, Petrie, Green, Richards, Eramian and Rijke (2017), who consider it the most important feature of a repository. The second challenge is to develop prototypes that guide the creation of the repository based on the needs of its users (Meyerson, Galloway & Bias, 2012). Based on this challenge, the user must acquire a set of skills and competencies to understand the purpose of a repository and then generate the needs of the product. For this reason, Toikkanen, Purma and Leinonen (2010) emphasize the dissemination of the repository through the training of teachers about its usefulness as a priority, so that when they use it new patterns of behavior within the system and the real needs of teachers can emerge.

When introducing a technological innovation in any context, users must go through a process of adoption and acceptance, so it is essential to take into account the motivations of an academic

community to use a repository, as well as the needs of the institution. UCD seeks to place the user at the center of the process and the developer as a facilitator and mediator in the redesign of new interfaces (Norman & Draper, 1986; Johnson, 1998), without forgetting that the information architecture, the design of the repository and any innovative solution techniques are based on the vision they acquire by understanding the needs; proposals to develop these aspects fall on them, so it is essential to seek communication strategies between developers and the academic community (Leinonen, Purma, Poldoja, and Toikkanen, 2010).

Millard, et al., (2013) carried out an evaluation of the use of their HUMBOX repository, which revealed that in order to reduce barriers to share resources in a Repository, professionals must be assured of a secure digital space, since professionals traditionally do not share their materials or approaches in public out of concerns of plagiarism or other ethical questions. Without an evaluation, it is difficult to know the concerns of users. Therein lies the importance of the evaluations: analyzing the results reveals the problems faced by users, which then provides a clearer path to come up with solutions. That is the approach by Chacón-Pérez, Hernández-Leo, Mor and Asensio-Pérez (2016) who, by including reviews based on different feedback sources (from students, other educators, self-assessments), validated the fulfillment of various criteria and improved the service by making it custom-tailored to the users' needs.

Based on our findings, the contribution of the present literature review is to present the studies that have used the UCD methodology in repositories, with the purpose of emphasizing the need to develop a framework of best practices of UCD and repositories that can guide teams of the Educational Institutions that promote Open Access Knowledge to develop repositories that are useful, accepted and usable by their academic communities.

ACKNOWLEDGMENT

This research work has been completed within the Ph.D. in Education in the Knowledge Society of the University of Salamanca, Spain. The study has been recorded in the framework of Project 266632 "Binational Laboratory for the Intelligent Management of Energy Sustainability and Technological Training", with financing from the CONACYT-SENER Energy Sustainability Fund (call: S0019¬2014¬01). The author is grateful for the Fund's support and to Tecnologico de Monterrey as the project manager. Also, this paper is in the scope of the Spanish Ministry project DEFINES (ref TIN2016-80172-R).

REFERENCES

Chacón-Pérez, J., Hernández-Leo, D., Mor, Y., & Asensio-Pérez, J. I. (2016). User-centered design: supporting learning designs' versioning in a community platform. In *The Future of Ubiquitous Learning* (pp. 153-170). Springer Berlin Heidelberg.

Clements, K., Pawlowski, J., & Manouselis, N. How do we measure open educational resources repositories success? A Systematic literature. Why Open Educational Resources Repositories Fail. In *Edulearn15: 7Th International Conference on Education and new learning technologies*, Barcelona, Spain.

Dalrymple, O. O., Bansal, S. K., & Gaffar, A. (2014). User research for the instructional module development (IMOD TM) system. In *Proceedings of the 121st ASEE Annual Conference and Exposition: 360 Degrees of Engineering Education*. American Society for Engineering Education.

Farwick, M., Schweda, C. M., Breu, R., & Hanschke, I. (2016). A situational method for semi-automated Enterprise Architecture Documentation. *Software & Systems Modeling*, *15*(2), 397–426. doi:10.1007/s10270-014-0407-3

Ferran, N., Guerrero-Roldán, A. E., Mor, E., & Minguillón, J. (2009, July). User centered design of a learning object repository. In *Proceedings of the International Conference on Human Centered Design* (pp. 679-688). Berlin, Heidelberg: Springer. doi:10.1007/978-3-642-02806-9_79

Gaona Garcia, P. A. A., Martin-Moncunill, D., & Montenegro-Marin, C. E. (2017). Trends and challenges of visual search interfaces in digital libraries and repositories. *The Electronic Library*, *35*(1), 69–98. doi:10.1108/EL-03-2015-0046

García-Peñalvo, F. J. (2017). *Revisión sistemática de literatura en los Trabajos* [de Final de Máster y en las Tesis Doctorales]. Grupo GRIAL, Salamanca, España. Retrieved from doi:https://repositorio.grial.eu/handle/grial/813 10.5281/zenodo.399302 Retrieved from

García-Peñalvo, F. J., Merlo-Vega, J. A., Ferreras-Fernández, T., Casaus-Peña, A., Albás-Aso, L., & Atienza-Díaz, M. L. (2010). Qualified Dublin Core Metadata Best Practices for GREDOS. *Journal of Library Metadata*, *10*(1), 13–36. doi:10.1080/19386380903546976

González-Pérez, L. I., Ramírez-Montoya, M. S., & García-Peñalvo, F. J. (2016). Discovery Tools for Open Access Repositories: A Literature Mapping. In F. J. García-Peñalvo (Ed.), *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'16),* Salamanca, Spain, November 2-4 (pp. 299-305). New York, NY: ACM. doi:10.1145/3012430.3012532

Hassan-Montero, Y., & Ortega-Santamaría, S. (2009). *Informe APEI sobre usabilidad 3*. APEI, Asociación Profesional de Especialistas en Información.

ISO. (1999). *ISO 13407: Human-centred Design Processes for Interactive Systems*. Geneva: International Standards Organisation. Also available from the British Standards Institute, London.

Johnson, R. R. (1998). User-centered technology, a rhetorical theory for computers and other mundane artifacts (Part II and III). Albany, NY: State University of New York Press.

Jokela, T., Iivari, N., Matero, J., & Karukka, M. (2003, August). The standard of user-centered design and the standard definition of usability: analyzing ISO 13407 against ISO 9241-11. In *Proceedings of the Latin American conference on Human-computer interaction* (pp. 53-60). doi:10.1145/944519.944525

Keele, S. (2007). Guidelines for performing systematic literature reviews in software engineering Technical report, Ver. 2.3 EBSE Technical Report. EBSE: sn.

Leinonen, T., Purma, J., Poldoja, H., & Toikkanen, T. (2010). Information architecture and design solutions scaffolding authoring of open educational resources. *IEEE Transactions on Learning Technologies*, *3*(2), 116–128.

Magües, D. A., Castro, J. W., & Acuna, S. T. (2016, October). HCI usability techniques in agile development. In *Proceedings of the IEEE International Conference on Automatica (ICA-ACCA)*. IEEE.

Martínez Abad, F., Rodríguez Conde, M. J., & García-Peñalvo, F. 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.

Millard, D. E., Borthwick, K., Howard, Y., McSweeney, P., & Hargood, C. (2013). The HumBox: Changing educational practice around a learning resource repository. *Computers & Education*, *69*, 287–302. doi:10.1016/j.compedu.2013.07.028

Norman, D. A., & Draper, S. W. (Eds.). (1986). *User-Centered System Design: New Perspectives on Human-Computer Interaction*. Hillsdale, NJ: Lawrence Earlbaum Associates.

Schön, E.-M., Thomaschewski, J., & Escalona, M. J. (2017). Agile requirements engineering: A systematic literature review. *Computer Standards & Interfaces*, *49*, 79–91.

Toikkanen, T., Purma, J., & Leinonen, T. (2010). LeMill: A case for user-centered design and simplicity in OER repositories. Free and Open Source Software for E-Learning: Issues, Successes and Challenges: Issues, Successes and Challenges.