User experience of an institutional repository in a private university in Mexico

A fundamental component in the framework of Open Science

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Abstract

Technology platforms, as viewed from the perspective of their users, provide new perspectives to

discover aspects to enhance its use. The objective of this study is to provide the instruments and

indicators that allow us to obtain empirical evidence of the experience of users of an institutional repository through the user-centered design methodology. The guiding question of the study was: How can we measure the experience of users who use an institutional repository? We employed a sequential mixed explanatory methodology and user-centered design, with the use of focus groups and surveys, applied to a sample of students and teachers. The findings identify three key factors that must be considered in promoting positive experiences for users; that is, normalization of the use of institutional repositories, the versatility of technology, and innovation in communication strategies to increase knowledge transfer in an open format.

Keywords

Open Science, Open Access, institutional repositories, user experience, technology acceptance model, TAM, evaluation of technology learning, design centered user, UCD, UX.

Introduction

One of the challenges for universities is to increase the transfer of knowledge to the industries and communities in their environment as a new way of conceiving research and teaching and to generate a potential source of wealth. Arechavala-Vargas and Sánchez-Cervantes (2017) point out that European universities are more aware of their economic responsibility to the region that supports them and in the United States, universities are perceived as a fertile field of opportunity for entrepreneurs. It can be said that the purpose of the link between universities, companies, government and society is to increase innovation in the environment through the use of technology in order to find solutions to emerging problems through innovation.

In order for universities to meet the challenge, they need to create management and communication strategies that allow them to develop the capacity to generate scientific research from the "science-technology-innovation" knowledge chain (PECiTI, 2014). In Mexico there is a great opportunity to create and promote models and strategies that promote the training of researchers in public and private universities with the aim of creating a culture of open innovation and open research and thus increase the social impact.

The Tecnologico de Monterrey is a private non-profit Mexican Institution of Higher Education, founded in 1943 by Mr. Eugenio Garza Sada (Tecnologico de Monterrey, 2018) and its main strengths are research and scientific developments that contribute to the economic development of Mexico and the World. Therefore, in recent years its researchers have ventured into partnership with different governmental, national and international bodies to develop innovative projects with social impact and open innovation.

The initiative of this study focused on generating a set of indicators that collect information from users and the results facilitate considerable improvements in the processes of searching and self-archiving resources within the institutional repository of the Tecnologico de Monterrey. Therefore, this study collected information from users who use it, to add improvements in the search processes and deposit of resources within the Repositories. The study was designed under the methodology of User Centered Design (UCD), which gives priority to customer satisfaction and makes short advances in software development to be validated by users and is carried out in four phases: a) Context of use, b) Requirements, c) Design and d) Evaluation.

In the following sections, we explain how the indicators were designed. First, a scheme was developed to determine which instruments would be applied in each phase. In the phase of context of use, a survey was designed to collect demographic data and current use of the Institutional Repository; In the requirements phase, a series of indicators were made to explore the

motivations and expectations that users have through focus groups; In the evaluation phase, the objective was to measure the perception of utility, ease of use, attitude and intention of use when searching and depositing resources in order to measure technological acceptance in relation to the user's experience.

The findings suggest that three key aspects could be considered to promote satisfactory experiences of users in relation to the open educational movement:

a) Create immersion strategies: One finding was that the more convinced they feel about their self-efficacy with the use of technology, the initial interaction they have with the use of the Repository system will be crucial to increase the perception of ease that has regarding the Repository. On the other hand, if they know the practices of the Open Educational Movement, the perception of utility will increase significantly. If the perception of ease of use and the perception of usefulness increases, the effective acceptance of the Repository as well as the user experience within the Academic Community could be ensured.

b) Establish the regulations for its use: To promote the use and production of scientific information in an open format, it was identified that users prefer to be provided with quick guidelines, workshops and short courses to understand the concept of Open Science, in this way the institution provides a clear route of its use.

c) The versatility of the technologies: One of the most widely used open platforms to implement Institutional Repositories is the DSpace, for its functionalities to preserve and make open educational resources interoperable, however there are still restrictions in its functionalities, use of web 2.0 tools, machine learning, data mining, and automated workflows, so developers must be very creative to interact with other platforms.

Study Objective

This study provides empirical evidence of the strategy that was developed to understand users' experience when self-archiving and searching for open educational resources in an institutional repository. Through focus groups and surveys for which a series of instruments and indicators were designed that allowed the motivations and expectations of the users to be examined and the purposes of their usage to be identified. Furthermore, the study evaluated the technological acceptance of the repository and, with the information gathered, a multidisciplinary team from Tecnologico de Monterrey formulated a series of goals to improve the services and functionalities of the Institutional Repository to improve the services and functionality of the Institutional Repository of the Tecnologico de Monterrey: RITEC. See Table 1.

Table 1

Services and functionality of the Institutional Repository of Tecnologico de Monterrey

Services	Functions
Redefinition of the information architecture according to mandatory metadata of the National Repository and metadata standardization of the Tecnologico de Monterrey.	Migration of the version of DSpace 3.2 to 5.2.
	Interoperability with the National Repository of Open Educational Resources.
Confirmation of the authenticity and integrity of the data.	

Redefinition of workflows for self-archiving resources according to metadata.	Dissemination of RITEC resources through APIS that connect with Google Scholar, SCOPUS, and ORCID.
Development of a simple and advanced search interface prototype and resource self-archive.	Configuration of REST catalogs.
Definition of Institutional Policies and legal frameworks.	Configuration of SWORD services to interoperate with the CRIS (Current Researcher Information System) system.

This study was developed with the support of two projects. The first one, commencing in 2016, was awarded to the Tecnologico de Monterrey by the National Council of Science and Technology (CONACYT, 2015) in Mexico. The project, named "Binational Laboratory for the Intelligent Management of Energy Sustainability and Technological Training", consists of creating educational innovation programs and carrying out innovation with open technologies to increase specialized talent for the energy value chain, based on a series of courses applying MOOC technology to energy issues and incorporating the practices of the open educational movement to promote open science. The second one began in 2016 with the support of CONACYT (CONACYT, 2016) in order to improve RITEC through the project "Increase in the visibility of RITEC, improving the user experience and its interoperability with the National Repository". The objective of this project was to develop the socialization of knowledge by increasing the stock of theses self-archived in RITEC, ensuring the interoperability of RITEC with the National

Repository and improving the user experience when self-archiving and searching for open educational resources.

Smart search engines, such as Google, and the massive exchange of information through social networks encourage the increase of sources for finding information. Universities' services need to integrate technological innovations with the services offered. Not only is technology innovation vital to teaching-learning processes; it is also necessary to identify interactions that increase the users' favorable experience of it. The Institutional Repositories are supported by open technologies that have been designed to manage scientific information and give visibility on the Internet to scientific knowledge in a safe way which is why it is necessary to promote its evolution in educational contexts.

In January 2018 the Tecnologico de Monterrey published its open access policy to guide and define the open practices that its academic community would use to make the educational and scientific contents produced by them freely accessible through its institutional repository RITEC. In this way, it was aligned with the mandate of the Science and Technology Law in Mexico. The objective of this law is to ensure that the scientific products that emanate from research financed with public funds are held in open access format in institutional repositories. Moreno (2017) defines the social appropriation of knowledge as an act that allows any citizen to access, read, copy, use, modify, reuse and share the content of scientific publications without any legal, economic or technological barrier, recognizing the attribution of authorship. The creation of the law of open access in Mexico seeks to provide open access to scientific products generated with public resources.

Technologies tend to evolve, and their updates seek to resolve issues, in response to new needs; thus, they seek to promote innovation and meet the needs of potential users. In order to redesign the interfaces and processes of any technology, it is necessary to know its current status,

to formulate goals for a defined period of use, and determine the scope of the redesign. One way of achieving this, in institutional repositories, is to identify a set of criteria that allow us to measure their attributes, adding value to technological innovation and simultaneously addressing the needs and motivations of users.

Framework

Increasing the transfer of scientific knowledge requires that universities have the willingness to raise awareness among researchers about the importance of a culture of open access and encourage them to develop skills such as the adoption of new research practices. Ramírez-Montoya and Ceballos-Cancino (2017) identify the benefits of open access for both the institution and its researchers, such as the possibility of improving their position in rankings, ensuring the preservation of their scientific production, gaining visibility and an increased presence on the Web, increasing the impact of citation, promoting international scientific collaboration, promoting innovation in research, and responding in an agile manner to national policies that promote open access to scientific production generated by projects financed with public funds. Martiny, Pedersen and Birkegaard (2016) point out that in order to take full advantage of Open Science and open up knowledge in the social context, three challenges must be addressed:

Challenge 1. Communication: the current regime of publication in international journals eliminates the motivation to use and appropriate modern means of scientific communication.

Challenge 2. Collaboration: scientists need to be willing and able to collaborate using online tools and share their final results in journal publications with others. The current scientific landscape and research education do not provide sufficient incentives and skills to evolve new research practices.

Challenge 3. Culture: a cultural change is needed to use the internet and various online tools that allow publications to be fully incorporated in the knowledge processes of science. This change requires a general reformulation of how to do science.

For Ramírez-Montoya, García-Peñalvo and McGreal (2018) open science is based on an editorial ecosystem and a technological ecosystem. García-Peñalvo, García de Figuerola and Merlo (2010) point out that the open educational movement is disseminated in two ways: a) open access journals (goldway) and institutional repositories (greenway). For García-Holgado and García-Peñalvo (2017), the technological ecosystem that forms the basis of the so-called open access greenway consists of components and services that allow open dissemination, where the central component of this technological ecosystem is the institutional repository and it develops the integral management of the life cycle of open scientific knowledge, in which, the data repository is a fundamental element of that system installed on Dspace as an open source tools (García-Holgado and García-Peñalvo, 2018).

Institutional repositories are implemented on technological platforms that support protocols to interconnect with each other, which is why they are constantly evolving. One of the most outstanding services an institutional repository offers is interoperability with various indexing platforms, as well as with applications that allow measurement of the impact that they have through citation in other studies, indicating the academic community to which the researchers belong. According to García-Peñalvo (2018), scientific communication has changed a traditional communication model to a communication 2.0 model and, in addition to this, Open Science has acquired greater relevance, making it essential that researchers adopt new practices to give visibility and free access to the knowledge generated and properly manage their scientific identity on the Internet.

An institutional repository requires not only an adequate technological infrastructure, but also policies, guidelines and standards of scientific resources that will be preserved and disseminated through it to provide a set of well-organized and interconnected services. Piwowar et al. (2018) identified five categories for classifying open access paths for publishing journal articles, as described below:

Gold: Articles published in open access journals are indexed in the Directory of Open Access Journals (DOAJ).

Green: Articles published in priced journals and any previous (pre-print) or final (post-print) copies are protected in a freely accessible format in the institutional repository of a particular University.

Hybrid: Articles that are published in priced magazines, but are immediately free when the author makes a payment to release them and they are self-archived in the institutional repository.

Bronze: Free articles to read on a web portal, but without a clear license for their use.

Closed: All articles that are shared on academic social networks (ASN) or Sci-Hub and LibGen.

Institutional repositories are included in the green category, with the author being responsible for the self-archiving of their research articles, considering the permissions of the journal. It is very important that the researchers know the implications of using each of the open access routes and thus choosing the path that can best enhance the visibility of their articles. On the other hand, the institutions, ideally, should know the motivations, expectations and concerns that researchers have when participating in open access practices by using the institutional repository and thereby foster a new culture with guidelines that help researchers. The relationship

that people have with the use of technology influences their attitude towards it and this is the case with institutional repositories, so it is vital to use strategies that enable researchers to understand the processes that are necessary when using it, such as managing the visibility and dissemination of scientific information resources in an open and free format. A strategy which universities can use to increase the acceptance by researchers of the use of an institutional repository is the creation of user experience models in which the first step is to understand the experience they have when interacting with it. In this way, means of increasing the perception of usefulness and ease of use can be identified.

A survey conducted by Bongiovani, Gómez and Miguel (2012), based on SOAP (Study of Open Access Publishing), allowed them to recognize the importance of knowing the opinions and publishing habits of their scientific community with regard to open format, realizing that it was key to identifying the tendencies and possibilities of its cultural and technological development. Undoubtedly, creating an open access institutional policy is a way of promoting an approach by the community to publishing their articles in open access, thus contributing to the social appropriation of knowledge.

The user experience is defined by the International Standard ISO 9241-210, 2010 as the emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors, and achievements that occur before, during, and after the use of a technological system. Vermeeren et al. (2010) distinguish the concept of user experience as the center of the experiences lived by the user; that is, knowing what users feel when interacting with the system and addressing subjective qualities such as motivation and user expectations regarding the system, unlike the concept of usability that only focuses on the performance of tasks and uses measures such as the duration of tasks and the number of clicks or errors. García-Peñalvo (2017) emphasizes that the future of institutional repositories, assuming that a training and information strategy was designed to

provide solutions to define the digital profile of researchers, is to provide components aimed at maximizing the end user experience through well-defined workflows and value services such as data mining and machine learning.

Institutional repositories have several challenges as a technological platform and one of them is that users who look for information in them should find relevant, flexible information and be able manage it effectively. The search interfaces require a structure of metadata so that the organization of information is of quality and can be supported as a Knowledge Organization System (KOS) (Solomou and Papatheodorou, 2010), thus providing satisfactory experiences when searching for resources through an attractive visual interface that guarantees the recovery of information in an appropriate way and the relevance of the results to what users are seeking.

For the redesign of interfaces, the authors Gaona-García, Martin-Moncunill and Montenegro-Marin (2017) recommend using the KOS method and they propose consideration, for the search interfaces of the institutional repositories, three aspects based on KOS:

a) Visualization techniques: The interfaces with the highest scores for the aesthetic indicators and classification methods in the knowledge representation schemes were: 1) relationship, 2) radial, and 3) tree. The results indicated that the interface type "relationship" provides a high value for aesthetics but has difficulty in representing hierarchies, which is a significant disadvantage.

b) Graphic components: In this category, the tree and radial interfaces are the most suitable for the deployment of hierarchical structures, rich vocabulary management, relationships, and association hierarchies, as well as for the integration of search methods specifically oriented to cover a subject or area of knowledge.

c) Metadata structure: for this category, it was discovered that the tree and radial interfaces are the best options for facilitating the navigation and implementation processes based on previously established KOSs.

Furthermore, the interface redesign must necessarily be aligned with a software development methodology. For the investigation of user experiences the methodology of User Centered Design (UCD) was used, which is oriented to the development of software focused on the needs, characteristics, and goals of potential users (Hassan-Montero and Ortega-Santamaría, 2009). The ISO 13407 standard, revised by ISO 9241-210, 2010, establishes four phases for the UCD (see Figure 1) described below.

1. Context of use: conditions and people where the product was developed.

2. Requirements: product objectives.

3. Design: system solution.

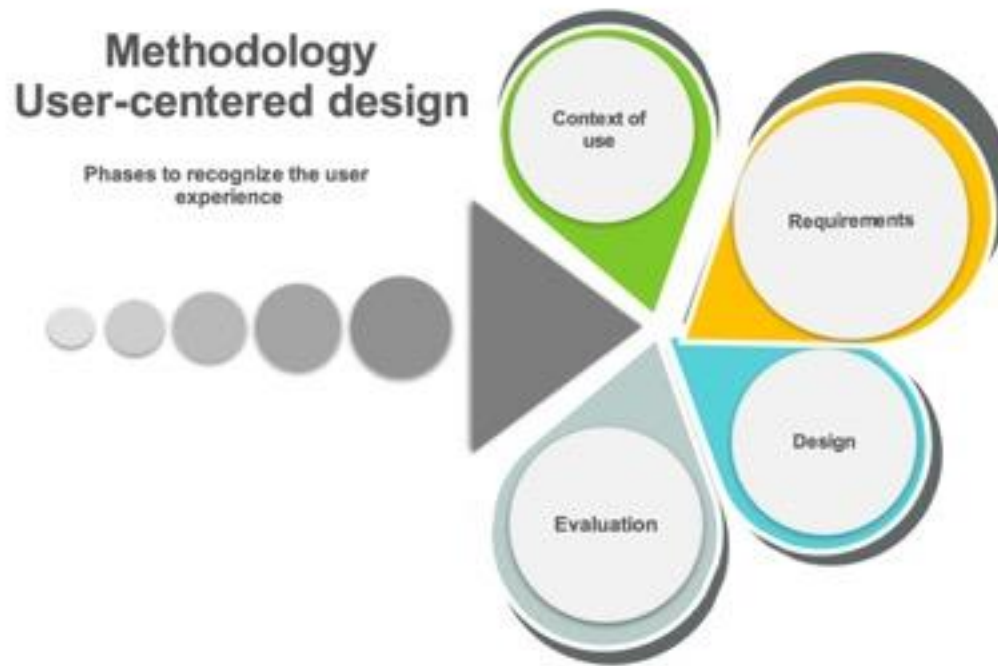4. Evaluation: validation of the requirements, usability problems and tests with users.

Figure 1. User-Centered Design Methodology (own description)

The context of use is delimited by the place and the qualitative or quantitative description of the users of a system and the characteristics of the place where the research is applied. Ferran, Guerrero-Roldán, Mor, and Minguillón (2009) point out that in order to identify the users' needs when conducting searches, it is necessary to use the users' information and navigation behavior, know demographic aspects and evaluate users' skills when using Institutional Repositories.

To understand the requirements of a product for its clients or potential users, UCD techniques are used that allow the gathering of information to give an approximation of what they expect. Buchan (2014) proposed a mental model to understand the requirements of users and thus know how users think, because to achieve an effective design it is necessary to do so as a function of what the users want. In many cases, the interfaces of an Institutional Repository have been designed from the perspective of librarians, software engineers and programmers.

For the design Rivero et al. (2014) propose to use agile design prototypes and tools to make mockups to test the expectations of the system before employing them in the real system. The prototypes are schemes that help in understanding what different users want and allow an approach to be determined, thus agreeing a design based on an information architecture congruent with the technical aspects. Pandey and Srivastava (2014) emphasize that, in an era of massive information, it is essential to systematize well-defined data sets with visible relationships that allow the creation of a valuable repository of information, so that the designer can make decisions about the optimization of tasks and the creation of business intelligence in the system itself. They mention the advantages and methods of 'consuming' the user interface to increase user productivity and reduce the learning curve.

With the UCD methodology, in the evaluation phase, various techniques can be identified that allow information to be obtained on aspects of the product to be improved or improved by a redesign. González-Pérez, Ramírez-Montoya and García-Peñalvo (2018) carried out a systematic review of the literature on User-Centered Design in institutional repositories and found that the most widely used evaluation techniques are usability tests, user feedback evaluation of experts, and quantitative evaluations. There are indicators that focus on the evaluation of institutional repositories in respect of content, marketing, legal aspects, technical aspects and similar, and it is necessary to add indicators that assess the perspective of users. With technological advances, the evaluations of technological systems have been automated. For this reason, authors such as Xie (2009) propose a semi-automated quality-focused approach to user-centered evaluation, based on detailed indicators and a tool to support decisions.

Designing the user experience through the UCD methodology provides the possibility of having a plan and a timely follow-up to each phase of the redesign and has appropriate techniques for each of the phases. This study presents the design and results of a survey based on the

Technological Acceptance Model (TAM), which identifies the current acceptance of the use of

technology and predicts its use in the future. The Technological Acceptance Model, created by

Davis Fred (1989), is based on evidence of the perceived usefulness and perceived ease of use as

determining elements in the users' behavior when accepting or rejecting a technology. The author

defined perceived usefulness as the degree to which a person perceived that a particular system

improved their work performance and such factors as pay increases, promotions, bonuses, etc. By

contrast, the definition of perceived ease of use refers to the degree to which a person believes that

the use of a particular system is free of unnecessary effort.

The TAM Model has evolved over time and other variables have been added to each of

its constructs. Venkatesh (2000) proposed a specific framework for the variable, the perception of

ease of use, with three categories: 1) users' beliefs regarding the use of technology, 2) users'

expectations to adjust the system

system adjustment expectations that users have to increase their experience to increase their

experience and 3) users' experience relative to the length of time they have been using the system.
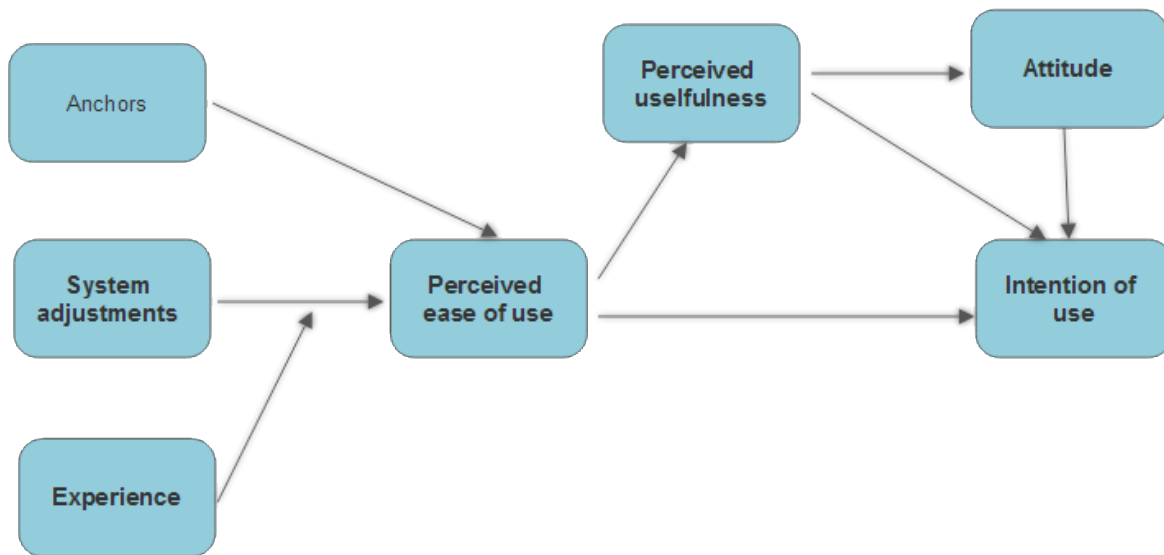
See Figure 2.

Figure 2. Technological acceptance model proposed by Venkatesh. (Venkatesh, 2000, pp.345)

Open technologies require research methodologies that cause them to evolve quickly and successfully so that they can be adopted more easily by their potential users. The implementation of an institutional repository implies the use of innovative practices that must be promoted within the academic community; a way to achieve user-centered use focused on the user and thereby identify the motivations of the end user in order to see the open educational movement. For Ramírez-Montoya and García-Peñalvo (2018) Open science has a long road ahead, to the promotion of changes that push for a culture of collaboration that promotes open knowledge for society and a strategy is to find theoretical frameworks can be found that contextualize the open scientific knowledge, from the contextual and disciplinary views where these open practices are being developed, up to the possibilities of joint construction. Therefore, it is important to create indicators that measure different aspects of the technology used in both the educational and the scientific contexts. An example of this is the integrated model of the TAM variables proposed by

Wu and Chen (2017) to apply technology task fit (TTF) to MOOC programs and identify the social motivations of the students who participate. The results found that measuring attitude can be the most powerful predictor of the intention to use technology in MOOC courses in the future.

Methodology

This study was conducted with a mixed sequential explanatory method in which qualitative and quantitative methods were complemented. According to Plano Clark and Creswell (2008), this method consists of using an explanatory sequential strategy on equal status which involves an initial phase of qualitative data collection and analysis followed by another phase where quantitative data is collected and analyzed. Normally, when the qualitative data is collected first, the intention is to explain the approach with a group of participants in their context, subsequently expanding the understanding of the problem in a larger sample and being able to generalize to the population (Creswell and Plano Clark, 2017).

In this research we worked in two phases in which qualitative and quantitative methods were combined. The information that was gathered through qualitative methods related to the motivations and the experience of researchers when using the institutional repository. With the quantitative methods, information was gathered to assess the acceptance of the repository and its usability.

The sample population for the application of the qualitative methods consisted of researchers and doctoral students at the Tecnologico de Monterrey. For the quantitative methods, the participants were the attendees on a training course regarding visibility of knowledge.

Additionally, pilot tests of each instrument were carried out to guarantee the validity and reliability of the study (González-Pérez, Ramírez-Montoya and García Peñalvo, 2018). It is worth

mentioning that rigorous ethical care was taken to protect the data of the participants in this study, to inform them about the study, and to ensure their data privacy.

To identify the experience of the users who use the institutional repository, the mixed method was used according to Plano, Clark and Creswell (2008) together with the User-Centered Design Methodology, based on the International Standard ISO 13407. For each of its phases, an instrument was selected and designed that facilitated the evaluation of the users' experience during each stage, allowing information to be gathered before proceeding to the next phase. See Figure 3.
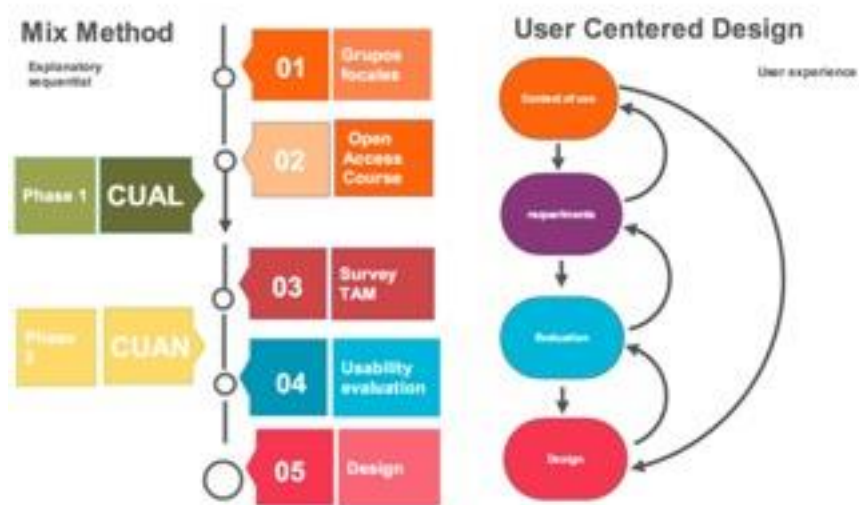

Figure 3. Instruments mixed method and the user-centered design methodology (own description)

The UCD techniques were performed three instruments according to the coding performed by Brhel et al. (2015). See Figure 4.
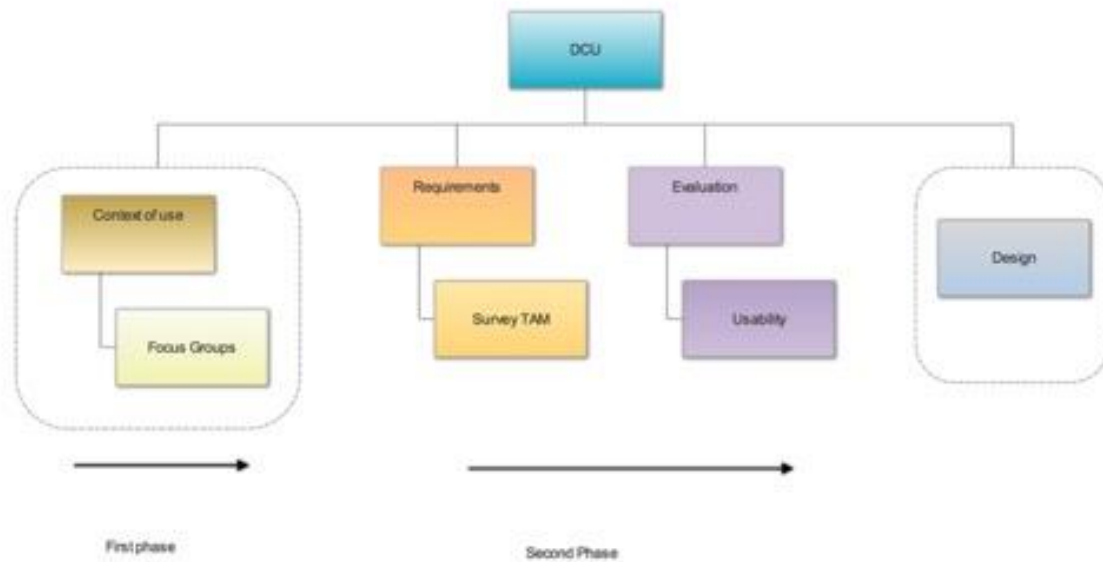
Figure 4. Instruments for data collection to evaluate the experience of users in institutional repositories (own description)

Phase 1: Collection technique for the context of use phase.

Focus groups allowed us to address the current motivations of people who use institutional repositories. See Table 2. (González-Pérez, Ramírez-Montoya and García Peñalvo, 2018).

Instrument available in: https://goo.gl/31GTce

Table 2

Indicators of the Focus Groups

Demographics data
Use of RITEC
Discovery tools

Information management
Motivations
Impact on research
Interface design

Phase 2: Collection technique for the requirements phase.

Technological Acceptance Survey: Four indicators were established to determine how ease of use relates to the perceived usefulness of the system and, thus, determine the purpose of use and the attitude that users have to accepting the technology of the institutional repository. See Table 3: (González-Pérez, Ramírez-Montoya and García Peñalvo, 2018).

Instrument available in: https://goo.gl/iQqJMc.

Table 3

Indicators of the technology acceptance survey

	Demographic Data	
	# questions for searches	# of questions to self-archive
Perceived usefulness	5	8
Perceived ease of use	8	8
Attitude	5	
Intention to use	3	

Analysis and Results

Results of the Focus Groups

The results of the focus groups indicated that the participants did not fully understand the purpose of using the institutional repository or the functionality it offers. 50% of the participants were unaware of the existence of the institutional repository, so they were offered help to update their skills and train in topics related to Open Educational Movement practices and the use of the institutional repository. This assistance was expected to facilitate a change of mindset regarding sharing, collaborating, and building knowledge. Moreno (2017) points out that the social appropriation of knowledge is understood as a process that implies, on the one hand, the provision of scientific information in a common scenario and language for society, and on the other hand, the human being.

The demographic data showed that the participants were 40% researchers and 60% phd students; 60% were women and 40% were men; 33% had PhD, 53% had a Master's Degree, and 13% had a Bachelor's degree. The average age of participants was 37 years. See Figure 5.
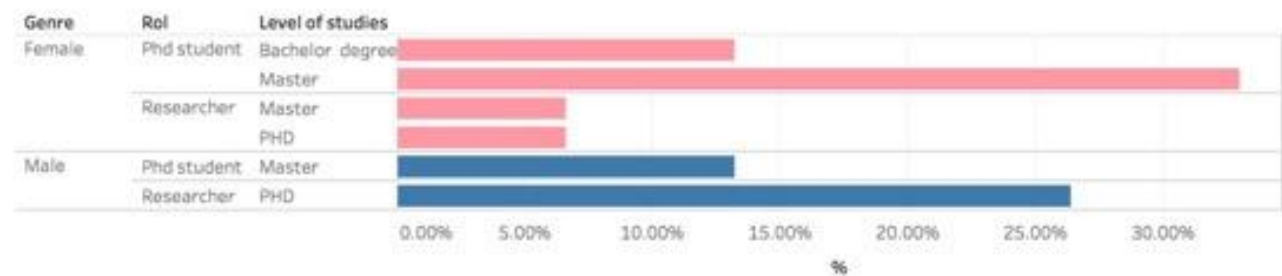

Figure 5. Graph of the demographic data collected in the focus groups (own description)

With regard to the level of use of RITEC, eight of the participants reported that "they did not know that there was an institutional repository or know its purpose"; four reported that "they had uploaded papers at the request of their academic program director", two said that "resources had been accessed at the request of the job leader" and two said that "their thesis was entered by

institutional request". Vermeeren et al. (2010) points out the importance of locating users at the center of experience, examining their knowledge and interaction with the system and subjective qualities such as motivation and expectations regarding the system

All the participants expressed their belief that a communication strategy is necessary to achieving an appropriate dissemination of information regarding the use of institutional repositories. They also stated the need to understand the institutional use policies and to have access to an effective support service.

Figure 6 represents the types of documents that the participants had uploaded. It shows that the participants had not uploaded journal articles and the self-archiving of the resources they uploaded was done at the request of an academic program director or team leader. It can be said that ignorance of the system leads to fewer jobs being self-archived and there is no motivation to do this except at the express request of a manager or leader.
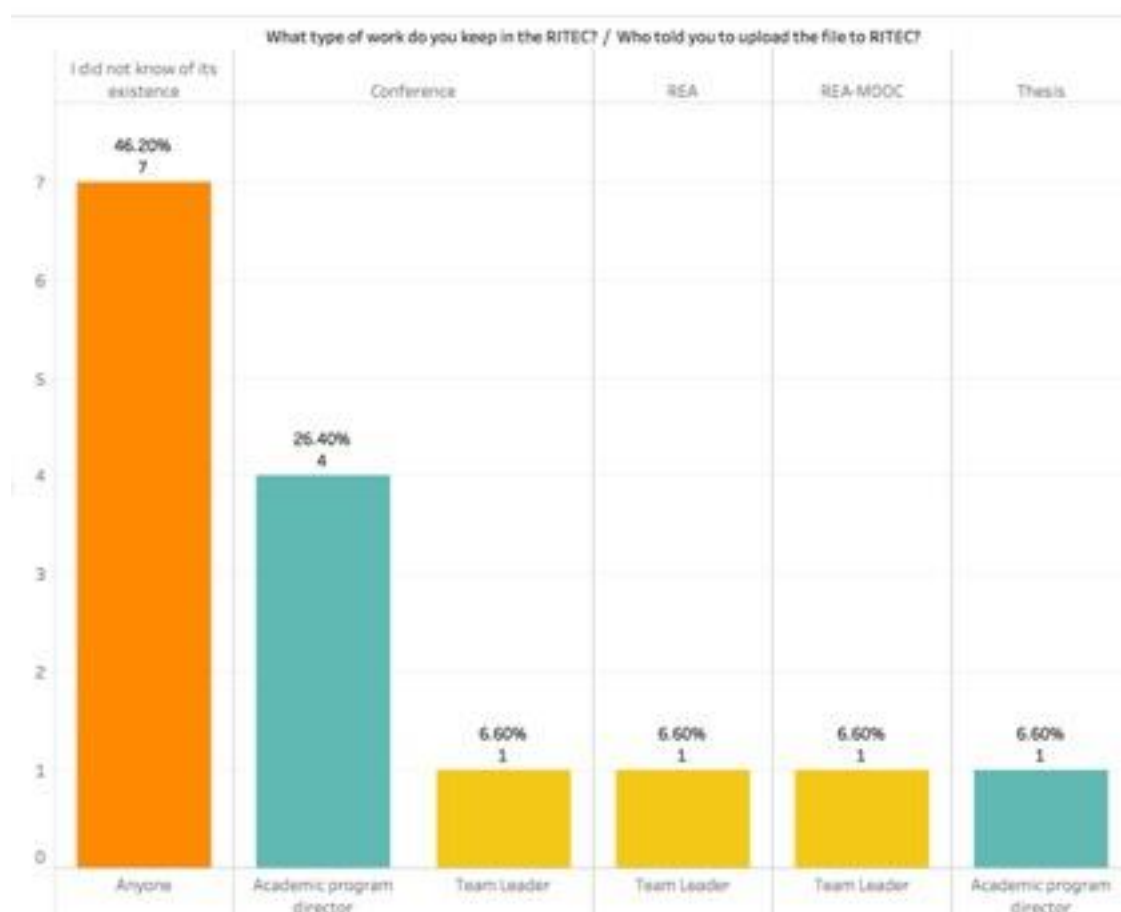
Figure 6. Graph of the use of the institutional repository by the participants of the focus groups (own description)

Open Science is strengthened by using digital platforms where the actors of one or more academic communities converge to publish, collaborate and disseminate their scientific production. The participants of the study expressed the belief that the design of the repository could be improved, ideally using a platform that would enable them to search and self-archive resources quickly and easily. Bongiovani, Gómez and Miguel (2012) point out that the motivation of researchers to use an institutional repository is related to the services provided, such as searches adapted to their needs, a user profile, statistical reports on the use of the work, and generation of an updated list of publications.

Results of the TAM Survey

The statistical results of the survey show that intention to use the institutional repository is high and, once they know its benefits, users decide to continue using it and recommend it to other colleagues. The perception of ease of use when using it is much lower, indicating a need to change the interfaces to make them easier to use and to have instruments that measure their usability. Another statistical finding suggests that the attitude towards use of the institutional repository is very favorable. The results focused on finding evidence of the beliefs that Venkatesh (2000) identified with regard to the use of technology by the user, the expectations of adjustment of the system to increase their experience, and users' positive experience of the system being related to the length of time that users have been using it.

The survey was distributed to 47 students enrolled in the virtual course "Visibility of open knowledge through the repository". The percentage of participants in the survey by gender was 68% women and 32% men. 53% of the respondents had a PhD, 39% had a master's degree, and 8% had a Bachelor's degree. See Figure 7.
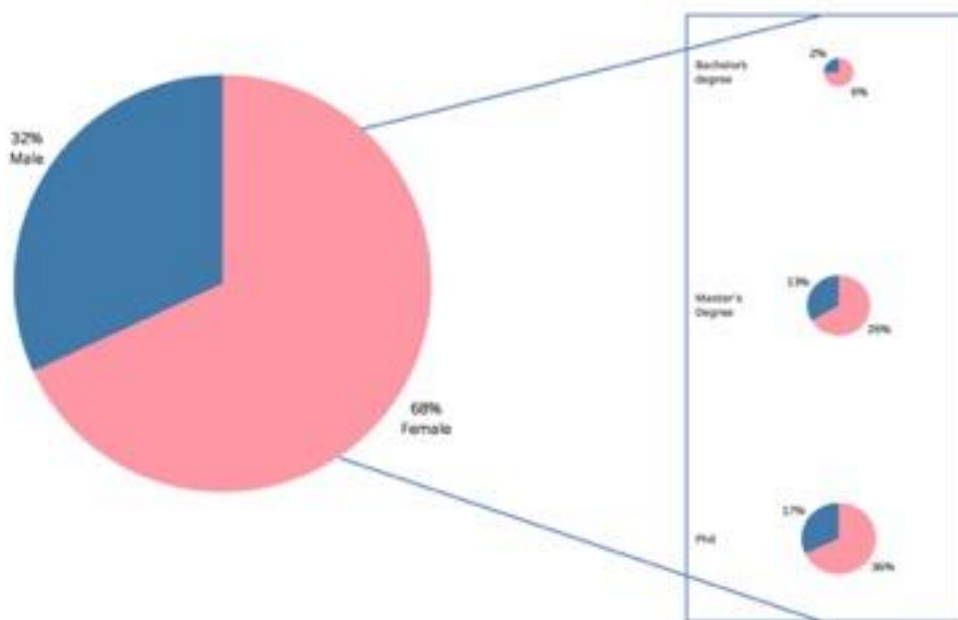
Figure 7. Graph of the demographic data collected in the TAM survey (own description)

To understand the relationship of users to the use of the repository, they were asked: What does the repository do? The response options were: a) search, b) self-archive, c) self-archive and search, and d) none. 68% replied that they used it to find resources, with 15% using it to self-archive resources, 6% to search and self-archive, and 11% not using it at all. It can be seen in Figure 8 that there was greater use of the institutional repository for search purposes than for self-archiving of resources.
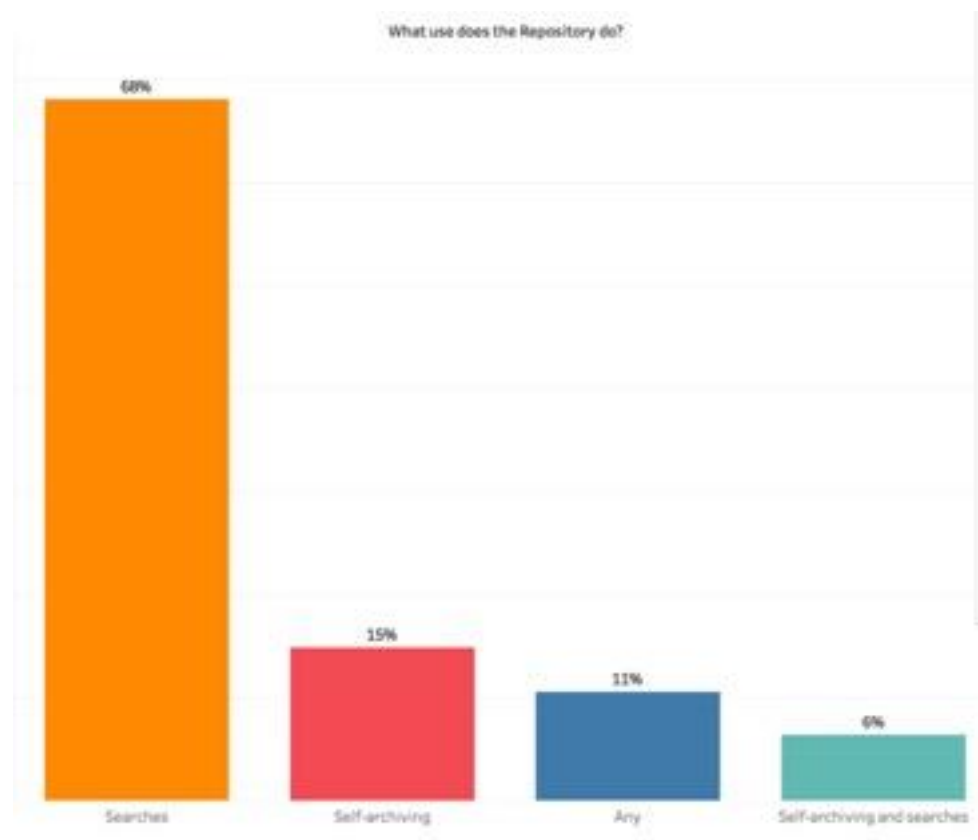

What use does the Repository do?

Figure 8. Graph of the type of activity carried out in the repository by the participants of the TAM survey (own description)

In addition, participants were asked how long they had been using the repository. 49% responded that they had used it for less than a year; 34% answered that they had used it for over a year, and 17% answered that they had never used it. See Figure 9
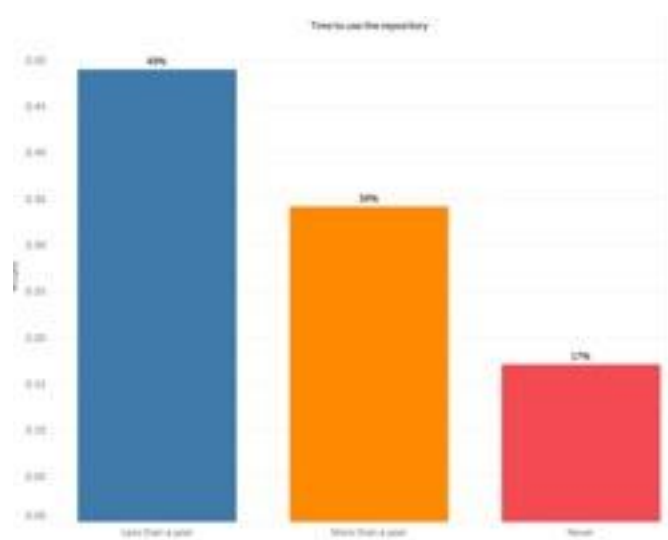

Figure 9. Graph of the time of using the repository by the participants of the TAM survey (own description)

According to the results shown in Tables 4 and 5, there is a slight preference for searching compared to self-archiving. Participants may be more willing to use the institutional repository if they can see that self-archiving contributes to the international reputation of the country and allows them to collaborate with an Institution's authors. Although, Ferran, Guerrero-Roldán, Mor, and Minguillón (2009) refer to identifying the needs when carrying out searches, using the information and the user's information and navigation behavior related to their competences, which are oriented to identify competences to search for information within the institutional repository.

Table 4

Usefulness when searching as perceived by the participants of the TAM survey

Measure names for Perception Usefulness when searching for resources in the IR	Average result
The Institutional Repository allows me to know authors of the Institution	3.59
I believe that the Institutional Repository is an adequate tool in my academic workflows	3.51
The Institutional Repository allows me to know academic resources of the institutional environment	3.50
Institutional Repository allows me to access the full texts of the resources of my interest	3.43
Institutional Repository allows me to obtain valuable information to perform my academic tasks	3.43

Table 5

Usefulness when self-archiving as perceived by the participants of the TAM survey

Measure names for Perception Usefulness when Self-archiving resources in the IR	Average result
I self-archive to contribute to the international positioning of my country	3.60

I self-archive because I contribute with the open access to knowledge to society	3.60
I self-archive to contribute to the international positioning of my institution	3.58
I self-archive because my resources are available to be consulted by my academic community	3.55
I self-archive because the impact of my scientific production can be greater	3.47
I self-archive my resources in the Institutional Repository because they are accessible to everyone	3.43
I self-archive because my visibility as an author will increase	3.38
I self-archive because I obey with the government mandates related to Open Science	3.26

Tables 6 and 7 show the results for ease of use and it can be seen that the time that users invest in self-archiving resources is lower than that spent in searching for information, so consideration should be given to making the self-archiving process simpler. Another important aspect of the results is that warning messages when self-archiving resources and searching are not understood by those who answered the survey. The perception of ease of use in the two activities is lower than the perception of usefulness. To increase the users' satisfaction in these areas it is important to identify methods for providing a better interface; for example, Gaona-García, Martin-Moncunill and Montenegro-Marin (2017) recommend using the KOS method to consider aspects such as visualization techniques, graphic components, and an adequate metadata schema. Another

example is the method used by Buchan (2014) that investigates users' requirements by using a mental model to understand the way they think.

Table 6

Ease of use when searching as perceived by the participants of the TAM survey

Measure names for Perception Ease of use when searching for resources in the IR	Average result
The organization of information is logical	3.37
The options allow to search the contents in a flexible way (theme, author, keywords, etc.)	3.32
I understand the language related to the search options.	3.30
By using the search engine, I get relevant results	3.23
I find it easy to navigate through the IR	3.19
Advanced search options allow me to refine my searches in a simple way	3.18
I understand the warning messages when searching (warning or error) in the IR	3.18
The navigation levels are clear	3.15

Table 7

Ease of use when self-archiving as perceived by the participants of the TAM survey

Measure names for Perception Ease of use when self-archiving resources in the IR	Average result

The video tutorials provide the information in a clear way to understand the way to make the self-archiving of my resources	3.48
The design of the IR y portal distinguishes through font sizes, menus, lists what I can do in the Repository	3.37
By self-archiving my resources in the Repository, I know what it means to choose a type of licensing in the IR	3.27
It is easy to enter the fields that are requested in the IR	3.14
I understand the warning messages when self-archiving my resources (warning or error) in the IR	3.12
It is easy to determine the sections in which I can self-archiving my resources in the IR	3.10
The warning or error messages when self-archiving in the IR are easy to understand	3.05
The time I invest in. self-archiving resources in the IR is adequate	2.93

The attitude of users to the institutional repository was very positive because the system helps them to be active members of their institution. See Table 8. García-Peñalvo (2018) points out that scientific communication has changed to a communication 2.0 model and Open Science has become more relevant, which is why it is extremely important for researchers to make their knowledge visible and thus be part of the digital communities.

Table 8

Attitude when use IR on the part of the participants of the TAM survey

Measure names for Attitude when use IR	Average result
The Institutional Repository makes me feel an active part of my Institution	3.53
I feel part of the open access being an active user of the Institutional Repository	3.47
I feel that my scientific and / or academic reputation is strengthened thanks to the Institutional Repository	3.43
The Institutional Repository has an attractive presentation	3.26
It is a waste of time to use the Institutional Repository	1.51

The intention to use the institutional repository was high. 90% of participants choose "recommend the use of an institutional repository to colleagues in their institution" and "Every academic institution must provide an institutional repository to its community". See Table 9. Institutions should create new forms of open access and provide means of facilitating it.

Table 9

Use intention of IR by the participants of the TAM survey

Measure names for use intention of IR	Average result
I would recommend the use of the Institutional Repository to colleagues of my Institution	3.66
I believe that every academic institution must provide an Institutional Repository to its community	3.57

An open access culture should promote the interest in using open technologies as a necessary development and instill that interest in the researchers, promoting the benefits of publishing via the various open access routes. The incorporation of strategies to promote open educational practices and contribute to open access knowledge depends on users being adequately trained, so it is important to provide courses, workshops, and conferences to publicize the concepts and practices successfully.

From the information gathered with the two instruments explained in this study, it is possible to move towards a user experience model which will make it possible to identify the causes and possible consequences involved in the interaction with a product or service and thus predict its use and value for the users. In addition, the importance of the University having training workshops to introduce the academic community to issues related to the visibility of open educational knowledge is emphasized.

Conclusions

The findings of this study to answer the guiding question: How can we measure the experience of users of an institutional repository? They indicate that parallel strategies are required that consider the normativity of their use of institutional repositories, the versatility of technology, and innovation in communication strategies to increase knowledge transfer in an open format.

The open access regulations are an important consideration for the institutions that develop initiatives and strategies to promote the use and production of scientific information in an

open format. Such regulations also increase confidence on the part of researchers and students. The main barriers found in this study were the lack of knowledge of the purpose and existence of an institutional repository and the benefits of using it in scientific activities. An important task is to develop immersion strategies to change users' beliefs about what the practices of the Open Access Movement mean and about the use of the institutional repository, considering that, in most cases, initial beliefs about interaction with the system are negative. A system is created in the early stage of the experience of its use and its self-efficacy with the use of technology, that is, what they believe about their experience with the use of technologies.

Providing greater versatility in open technologies is key to enhancing positive experiences in those who use them. As mentioned, we determined that in each stage of the User Centered Design Methodology, we need to explore and design more techniques that facilitate the gathering of certain information. In the case of the design stage, there is still much to be done, because this is where the plan to consider user requirements must be implemented. The most important element in determining the scope of a design based on what the user requires is a simple and accessible technological platform. In the case of institutional repositories, one of the most widely used platforms is the DSpace, which is designed to make open educational resources interoperable. Although there are limitations in its functionality, configuring personalized views, aspects of web 2.0, automatic learning, data mining, and other functionalities would allow searching and self-archiving of resources to be more highly automated. Also, vitally important are interfaces that are configured in an approved and categorized manner, using information capture labels related to metadata, vocabulary, information flows, and organization through maps and routes so that resources can be found with greater ease.

Consideration and promotion of research models to develop innovative strategies for increasing knowledge transfer in an open format should be focused on the motivation of users. In

the evaluation phase, user-centered design generates techniques and indicators that are not based solely on the usability of the product, but on other factors such as accessibility, findability, interoperability, security, etc. It is also important that, when evaluating the design, the product and the users of that product are clearly identified.

Finally, we recommend looking for new open strategies, such as training in the open educational movement, in situ exploration of users, as well as perspectives to analyze how web 2.0 functionalities can be added to the platforms that use institutional repositories. Such strategies invite interest and collaboration among specialists in relation to the evaluation or recommendation of their resources, allowing them to create projects and networks to generate greater interest in an initiative, or develop a common theme from a national or international perspective. By having social network functionality in the platform of an institutional repository, the impact of resources can be measured for the benefit of society. In addition, if the functionality of a social network is added to an institutional repository platform, it can be evaluated through the Technological Acceptance Model, adding additional constructs.

Although, until now, the evaluation of institutional repositories has been based on indicators that have focused on procedures, technologies, marketing, content, and library staff, we must also consider the characteristics of the profiles of the users who use the repository including their skills, their consumption habits, and their experience in the use of technology. Therefore, the initiative of this study focused on generating a set of indicators that collect information from users and the results facilitate considerable improvements in the processes of searching and self-archiving resources within the repositories.

User Centered Design (UCD) is conceived as an agile methodology to develop software, which is oriented to prioritizing customer satisfaction and aims not only to be based on planning or documentation of analysis and design, but on continuous deliveries of software development

validated and guided by those who use it throughout the development stage. This way of identifying the users' experience when interacting with institutional repositories helps to identify their motivations and measure their perception of usefulness and ease of use, attitude, and purpose of use when searching and self-archiving resources.

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