

Validity and reliability of a survey to know the technological acceptance of an institutional repository: The case of resources on energy and sustainability

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ABSTRACT

The purpose of this paper is to present the validity and reliability of a survey designed for technological acceptance of the Institutional Repository RITEC of Tecnológico de Monterrey with resources on energy and sustainability. The research question to be answered is: how does the user experience influence the success or failure of the acceptance of an Institutional Repository? The survey consists of four points in the Technology Acceptance Model (TAM): perceived utility (PU), perceived ease of use (EU), attitudes towards use (ATU) and intention to use (BIU). The pilot survey was applied to 47 students enrolled in the virtual course "Visibility of open knowledge through the RITEC". The results obtained from the reliability analysis, using Cronbach's alpha index, indicate the high internal consistency of the survey. The validity of the survey focuses on the content validity, valued by a group of experts.

CCS CONCEPTS

- Human-centered computing~User centered design

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KEYWORDS

User experience, Open Access Repository, survey; TAM; reliability and validity of a measure

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1. INTRODUCTION

The Open Access Movement is an international initiative that promotes access to scientific articles through the Internet, freely and free of charge, through two channels: the golden route consisting of publication in open access journals, and the green route that involves uploading this production in open access institutional repositories. The Open Science Movement is derived from this movement, promoting the sharing of data and auxiliary instruments used in scientific research in an open and free format so that they can be reused by other researchers and thus generate a new way of doing science [1]. Currently, institutional repositories are used as technological platforms that, in addition to the long-term preservation of documents, make it possible for

journal articles and other publications to be available on the Internet.

2. STATE-OF-THE-ART

When implementing an institutional repository in a university one of the biggest challenges is gaining acceptance by its academic community. An institutional repository requires executing tasks such as structuring, cataloging and reviewing information and implementing technology by specialized personnel; however, the academic community (students, professors and researchers), has two main tasks: self-archiving (uploading) and finding the resources available in it. The main challenge for the success of an institutional repository is to persuade its academic community to take the time to order their work, identify copyright information and self-archive those that are not subject to copyrights restrictions [2]. Therefore, it is essential to know the expectations and motivations of the academic community regarding the institutional repository and thus identify opportunity areas to improve its service and thereby promote open access and its practices.

Knowing the expectations of users is not the only factor to find opportunity areas in an institutional repository, since several evaluation indicators have been created that guide its development and evolution [3]: (1) technological, (2) processes, (3) content, (4) marketing and (5) personnel, which contribute to make the institutional repository a useful tool for the end user and the institution. See Figure 1.



Figure 1: Indicators created by Serrano-Vicente, Melero and Abadal [3]. Source: own elaboration

Each of the aforementioned indicators must specify the value with which they are measured, to know the result of each one for the Repository and thus make improvements in each necessary item, with the purpose of influencing in the increase of the users' experience regarding the tasks that involve them. The user experience is defined as "the aspects of the user's experience when interacting with the product, service or context" [4], from those interactions the perception of utility and the use of the product or service offered is formed [5].

The standard [6] focused on the User-Centered Design defines the user experience as emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and achievements that occur before, during and after use. Among the evaluation models of the Institutional Repositories, different aspects can be evaluated from this methodology that need to be assessed, but from the perspective of the users. Thus, the research question arises: how does the user experience influence the success or failure of the acceptance of an Institutional Repository? To answer the question, the way to evaluate the user experience was first identified from the technological acceptance of the RITEC. In its first version, the Technological Acceptance Model [7], established two dimensions that refer to use, defined as the degree to which a person believes that using a particular system would improve their work performance, which is related to positive use of the product. The second dimension refers to the perceived ease of use, that refers to the degree to which a person believes that the use of a particular system is effortless and claim that an application perceived as easier to use is more likely to be accepted by users

This survey is part of a set of instruments that were codified with the methodology based on the User Centered Design (UCD) within the evaluation phase. According to the coding of UCD [8], the evaluation can be categorized into three types: (1) evaluation by experts, (2) usability testing and (3) follow-up studies of installed systems (see Figure 2).

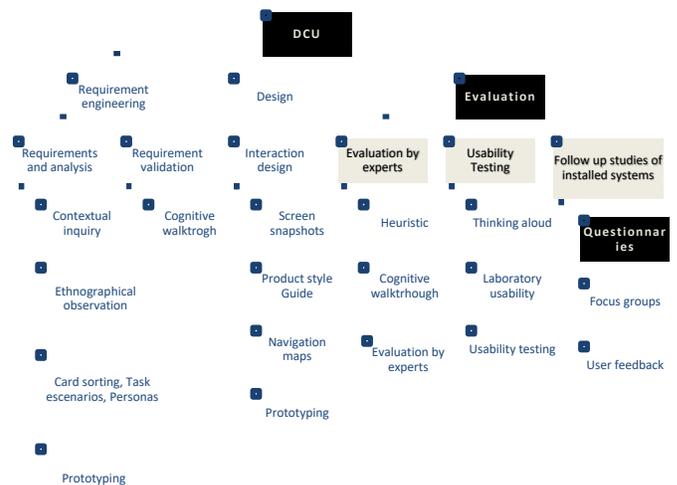


Figure 2. Evaluation techniques in the User Centered Design methodology [8]

Another coding of the systems evaluation is the User Centered Design perspective by [9], which integrates the tests into three evaluation methods (see Figure 3).



Figure 3. Evaluation methods according to [9]

3. RESEARCH METHOD

From the theoretical perspective of any scientific research, the research method provides a perspective of what happens in the context that is intended to enrich from the findings found in qualitative and quantitative approaches. The combination of quantitative and qualitative data, based on their strengths, allows a better understanding of the research problem [10]. Studies with mixed designs can be of two types: with a mixed model, combining quantitative and qualitative methods in the same research phase, and with a mixed method, in which quantitative methods are used in one phase of research and qualitative in another [11]. In this paper we will address the validity and reliability of a survey based on the Technology Acceptance Model (TAM) measuring four dimensions of TAM: perceived utility (PU), perceived ease of use (EU), attitudes towards use (ATU) and intention to use (BIU). The survey is one of the queries and continuity methods of evaluation of systems from the User Centered Design to know the results of the technological acceptance that the Institutional Repository of Tecnológico de Monterrey (RITEC) has in its academic community. The RITEC was implemented in 2013 and its purpose is to give access to educational and scientific contents that are produced by its academic community freely and free of charge. The academic community of Tecnológico de Monterrey is made up of students, professors and researchers and their interaction with the RITEC interfaces involves two main tasks: (1) self-archive tasks (upload of Open Educational Resources) and (2) search for Open Educational Resources, which contribute to preserve and give visibility to scientific and academic production.

A survey aims to gather as much information as possible to provide an impression about the participants, such as their age, gender and occupation, as well as behaviors and attitudes toward subjects or objects, at the time of the survey [12]. The design of a survey goes through five stages [13]: (1) preliminary planning, (2) preliminary tests, (3) final design of the survey, (4) data collection and (5) results.

3.1 Preliminary planning

In this stage, the validity of the content of the survey items for each domain was assessed by six judges, experts in disciplines such as technology and education; specialized in Institutional Repositories, two of them belong to the GRIAL Research Group from the University of Salamanca in Spain and four belong to the Tecnológico de Monterrey in Mexico. The objective was to collect the identification data and the technological acceptance that students and researchers have when interacting with the Institutional Repository of the Tecnológico de Monterrey (RITEC). The factors that were considered to select the survey items were based on the literature review in relation to the technological acceptance model (see Table 1).

The table of specifications on the assessment was submitted to each judge for two purposes: the first was to validate the relevance of the survey items regarding the dimensions according to the TAM model and the second was to issue, if any, observations in case the items seemed confusing, repetitive or leading.

Each of the experts was sent a document by e-mail that clearly specified the objective of the survey, its contents and the way in which they should contribute their assessment on the items as well as the relevance of each item, indicating not favorable with 0 and the favorable relevance with 1. The item is considered relevant if it obtained between 4 and 6 points, according to the sum of the six experts.

Observations and recommendations of the first expert judge's session:

1. Items should be organized in two sections according to the task: search and self-archiving (upload), in the perceived utility and perceived ease of use dimensions.
2. Item formulating in such a way that the responses are assessed through a Likert scale
3. In the perceived utility dimension, formulating the items oriented to obtain results of the beliefs that they have regarding the benefits obtained when using the RITEC in their research activities.
4. Balancing the number of items in the dimensions.
5. Changing the language used in some items to avoid confusion and repetition.

3.2 Preliminary tests

The revision of the language used and the item comprehension was reviewed by two postdoctoral researchers; immediately, the piloting of the instrument was carried out with the recommendations of the authors and the reviewers through the application of the survey in Google Forms to seven people who were participants of the first teaching of the virtual course "RITEC Visibility and through open knowledge".

Table 1: Categories of the survey with items for validation of experts

Categories	Number of items	General description of the items	Relevance
Usefulness of the repository: the degree to which a person believes that using a particular system would improve their job performance	11	Inquire how they use the RITEC to give greater value and increase the impact on their research activities.	0 relevant
Perceived ease of use: the degree to which a person believes that the use of a particular system would be effortless.	37	Investigating the perceived ease of use in search and upload of resources, ease to understand the language used in the upload flow fields, in navigating, in the instructions and audiovisual support materials. Understand the error and move on until the interaction ends.	26 relevant
Attitude: Any favorable or unfavorable assessment towards a certain conduct or fact	10	Feeling good to know that through RITEC you can find your research. Finding the design attractive and comfortable.	10 relevant
Intention of use: Intent to continue using the system or recommend it to others.	2	Recommendation to others for continuity of use	1 relevant
Total	70		

3.3 Final design of the survey

The final items were designed from the first expert judge’s session, the results of the piloting and the adjustments to the language of the survey. The items were based on the dimensions of the Technological Acceptance Model (TAM) which are: perceived utility (PU), perceived ease of use (EU), attitudes

towards use (ATU) and intention to use (BIU). (see Table 2 and Table 3).

Table 2: Demographic and current use items

Demographic items	Current use Items
7	2

Table 3: Categories of the survey validated by experts

Items	Search	Upload	Attitude (AT)	Intention to use (BIU)	Total
Perceived utility (PU)	5	8			13
Perceived ease of use (EU)	8	8			16
Attitude (AT)			5		5
Behavior Intention to use (BIU)				3	3
	13	16	5	3	37

The answers were designed to be answered through a Likert scale [14], which are statements that:

1. Expressing an opinion or feeling about an event, object or person.
2. Having positive and negative values
3. Being listed with a circle to the right so that the appropriate level is chosen according to the item (see Table 4).

Table 4: Likert scale for the survey

Strongly disagree	1
Disagree	2
Agree	3
Strongly agree	4
Does not apply	No-answer

The scales were assigned giving a value to each point of the scale and the score of is the average of all favorable items.

1. Data collection. This survey was taken by the 47 people who participated in the second course of the virtual course “Visibility of open knowledge through the RITEC” through a web form on Google, and it was the last activity that was programmed during the course.
2. Results. Items for each dimension in the final survey according to the reliability of the content.

4. RESULTS

Next, the items for each dimension in the final survey are presented according to the reliability of the content (see Tables 5, 6, 7 y 8)

Table 5: Final items for validation for perceived utility

Perception of utility: It is the degree to which a person believes that using a particular system would improve their work performance [7]	
When searching	When uploading
The Institutional Repository allows me to obtain valuable information to perform my academic tasks	I upload my resources in the Institutional Repository because they are available to everyone
I believe that the Institutional Repository is an adequate tool in my academic workflows	I upload my resources in the Institutional Repository because my resources are available to be consulted by my academic community
The Institutional Repository allows me to know academic resources of the institutional environment	I upload my resources in the Institutional Repository because my visibility as an author will increase
The Institutional Repository allows me to know authors of the Institution	I upload my resources in the Institutional Repository because the impact of my scientific production can be greater
The Institutional Repository allows me to access the full texts of the resources of my interest	I upload my resources in the Institutional Repository because I contribute with open access to knowledge to society
	I upload my resources in the Institutional Repository because I comply with the government mandates related to Open Science
	I upload my resources in the Institutional Repository to contribute to the international positioning of my institution

Perception of utility: It is the degree to which a person believes that using a particular system would improve their work performance [7]	
When searching	When uploading
	I upload my resources in the Institutional Repository to contribute to the international positioning of my country

Table 6: Final items for validation for Perceived ease of use

Perceived ease of use: It is the degree to which a person believes that the use of a particular system would be effortless and requires little time to achieve the task [7]	
When searching	When uploading
I find it easy to navigate through the Institutional Repository	The time I invest in uploading resources in the Institutional Repository is adequate
The organization of information is logical	By uploading my resources in the Repository, I know what it means to choose a type of licensing in the Institutional Repository
The navigation levels are clear	It is easy to determine the sections in which I can upload my resources in the Institutional Repository
Advanced search options allow me to refine my searches in a simple way	It is easy to enter the fields that are requested when uploading resources in the Institutional Repository
By using the search engine, I get relevant results	I understand the warning messages (warning or error) when uploading my resources in the repository
The options allow to search the contents in a flexible way (topic, author, keywords, etc.)	The warning or error messages when uploading in the Repository are easy to understand
I understand the warning messages (warning or error) when searching in the repository.	The video tutorials provide the information in a clear way to understand the way to upload my resources in the Institutional Repository
I understand the language related to the search options.	The design of the Institutional Repository portal distinguishes through font sizes, menus, lists what I can do in the Repository

Table 7: Final items for validation for attitude

Attitude: Any favorable or unfavorable assessment towards a certain behavior or fact [22]
The Institutional Repository has an attractive presentation
It is a waste of time to use the Institutional Repository
I feel I participate in open access being an active user of the Institutional Repository
The Institutional Repository makes me feel an active part of my Institution
I feel that my scientific and/or academic reputation is strengthened thanks to the Institutional Repository

Table 8: Final items for validation for intention to use

Intention to use: Continue using the product and recommend it to others
I would recommend the use of the Institutional Repository to colleagues of my Institution
I am in favor of open access to academic and scientific production through the Institutional Repository
I believe that every academic institution must provide an Institutional Repository to its community

Next, the analysis of the internal consistency is presented, we calculate the global Cronbach's alpha coefficient (see Table 9) and that of each of the dimensions (see Table 10).

Table 9: Global Cronbach's Alpha

Cronbach's Alpha	Number of items
.960	37

Table 10: Cronbach's Alpha for each dimension

	Cronbach's Alpha	Number of items
Perceived utility (PU)	.927	13
Perceived Ease of use (EU)	.935	16
Attitude (AT)	.751	5
Intention to use (BIU)	.711	3

For the elaboration of the instrument of Usability of the Institutional Repository RITEC, a questionnaire of 37 items of Likert scale from 0 to 4 was designed, where 1 corresponded to "strongly disagree"; 2 to "disagree"; 3 to "agree"; and 4 to "strongly agree". In the item proposal, four dimensions were considered:

perceived ease of use (16 items), perceived utility (13 items), attitude (5 items) and intention to use (3 items).

To analyze the internal consistency of the instrument, a pilot test was carried out, collecting the responses of the 47 students who were enrolled in the virtual course "Visibility of open knowledge through the RITEC". The basic data of this sample are presented in Table 11.

Table 11: Sample description

Frequency	%	Valid percentage
Male	15	32%
Female	32	68%
Total	47	100%

The students had access to the survey, which had previously been designed through a Google Drive form, in the virtual space created for the aforementioned course. Prior to its completion, students were informed about the purpose of the research that was to be carried out.

Table 12 shows the descriptive data (minimum, maximum, mean and standard deviation) obtained in the different items that made up the initial survey. According to these data, it can be stated that the average assessment made by the 47 students who participated in the pilot test is positive, since an average of 2.90 was obtained.

Table 12: Descriptive data

	Minimum	Maximum	Average	Std. Dev.
Item 1	1.00	4.00	3.19	.798
Item 2	1.00	4.00	3.37	.645
Item 3	1.00	4.00	3.15	.625
Item 4	2.00	4.00	3.18	.657
Item 5	2.00	4.00	3.23	.560
Item 6	2.00	4.00	3.32	.629
Item 7	3.00	4.00	3.30	.548
Item 8	2.00	4.00	3.18	.576
Item 9	2.00	4.00	2.92	.703
Item 10	3.00	4.00	3.27	.499
Item 11	1.00	4.00	3.10	.692
Item 12	3.00	4.00	3.14	.566
Item 13	3.00	4.00	3.12	.697
Item 14	1.00	4.00	3.05	.697

	<i>Minimun</i>	<i>Maximun</i>	<i>Average</i>	<i>Std. Dev.</i>
Item 15	1.00	4.00	3.48	.554
Item 16	2.00	4.00	3.37	.536
Item 17	1.00	4.00	3.43	.715
Item 18	2.00	4.00	3.51	.661
Item 19	2.00	4.00	3.50	.624
Item 20	2.00	4.00	3.59	.498
Item 21	2.00	4.00	3.43	.544
Item 22	1.00	4.00	3.43	.583
Item 23	2.00	4.00	3.55	.504
Item 24	1.00	4.00	3.38	.535
Item 25	2.00	4.00	3.47	.550
Item 26	1.00	4.00	3.60	.496
Item 27	1.00	4.00	3.26	.648
Item 28	2.00	4.00	3.58	.499
Item 29	2.00	4.00	3.60	.495
Item 30	1.00	4.00	3.26	.675
Item 31	1.00	4.00	3.49	.843
Item 32	1.00	4.00	3.47	.776
Item 33	1.00	4.00	3.53	.620
Item 34	1.00	4.00	3.43	.620
Item 35	3.00	4.00	3.57	.744
Item 36	1.00	4.00	3.53	.881
Item 37	1.00	4.00	3.66	.479

The initial questionnaire, composed of 37 items, yields a reliability index, based on the Cronbach's alpha of 0.960, which is a high reliability index that allows us to point out that the measures were consistent and stable.

The alpha Cronbach values between 0.70 and 0.90 indicate a good internal consistency [15], therefore, we can suggest, in light of the results obtained, that the measures were consistent and stable.

5. CONCLUSIONS

The results obtained from the reliability analysis, using Cronbach's alpha index, allow us to point out the high internal

consistency of the survey designed to know the technological acceptance results of the RITEC Institutional Repository of Tecnológico de Monterrey by its academic community. The survey is based on the Technological Acceptance Model that measures the perceived utility (PU), perceived ease of use (EU), attitudes toward use (ATU) and intention to use (BIU) and that was applied to 47 students enrolled in the virtual course "Visibility of knowledge open through the RITEC".

The purpose of this research was to validate the items of a survey that consists of four dimensions based on the Technological Acceptance Model (TAM) and that was developed to measure the acceptance of an Institutional Repository and answer a research question: how does user experience influences the success or failure of the acceptance of an Institutional Repository? This study was an effort that was successful because an instrument was generated to measure the degree of acceptance of an Institutional Repository in Universities. Although there are standards to evaluate institutional repositories, it is necessary to inquire about what the user experiences with it. For various authors, the dimensions of the Technological Acceptance Model (TAM) are not related to the dimensions of user experience that are subjective because they have to do with emotions. On the one hand, we are looking for technology to provide a positive experience to the individual who uses it based on their motivations, and to achieve this a context is designed to promote certain emotions [16], if those emotions are of pleasure, they can favor a continuing use, but if these generate emotions of pain, the use of said technology could be definitively canceled [17]. In this survey, the dimension of perceived utility is oriented toward the benefits that the product offers; we could say that the dimension of perceived ease of use can be a link to know positive or negative emotions of the users regarding what the product makes them feel. Knowing the attitude and intention to continue using the Institutional Repository can serve to immediately reflect aspects related to emotion and thus argue whether the product will continue to be used or not.

This survey would be more enriching if we added dimensions that would allow us to measure psychological aspects of the people who use it, such as those who [18] mention to have adapted a scheme based on [19] that guides the dimensions in measuring the needs that arise in people when experimenting the use of technology, for example competence, relationship, popularity, stimulation, meaning, security and autonomy. The results obtained argue that they allow identifying factors that increase positive emotional experiences, that is, satisfaction. In this survey we are oriented to identify what are the benefits and ease of the functionalities that a product provides to obtain information that allow us to know what aspects should be considered in the Institutional Repository and address functionalities that allow greater benefits in the researcher activity, that is, to make substantial changes in technology and identify how researchers

use it more frequently and thus enhance open access to knowledge.

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