Ergonomic Evaluation of the Portal of the Repository in the Health Area of UNIFESP: Proposal of Specifications and Ergonomic Recommendations for Its Interface

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Abstract. The Internet, together with the Digital Information and Communication Technologies (DICT), make it possible to create digital documents (DD) that are responsible for the preservation of cultural heritage, dissemination of information and strengthen the construction of knowledge. These DD allow a wide production, dissemination and preservation of information and, with the help of DICT, enable the communication between researchers and scientists, especially regarding the sharing of research results. Digital repositories are informational environments for managing and controlling the scientific and academic production of institutions and/or communities. They offer advantages such as unrestricted access, data interoperability and long-term information preservation. However, they may have gaps such as browsing failures, poor usability and accessibility, limited searches, poor disclosure of the environment, and little or no use of customizable services. In 2015, the institutional digital repository of the Federal University of São Paulo (UNIFESP) was implemented the digital repository in the health area of UNIFESP (RDUNIFESP). Their construction was not user-centered, prototyping tests were not performed, the authors felt difficulty in their navigation and, therefore, it is important to apply an ergonomic evaluation in the RDUNIFESP using the inspection techniques and usability tests, with the objective of supporting users in the development of their activities in a productive, intuitive and safe way. In this way, this work will evaluate and identify points of suitability and inadequacy of usability in RDUNIFESP, and propose specifications and ergonomic recommendations and contribute to the improvement of its interface.

Keywords: Ergonomics · Usability · Institutional digital repositories

1 Introduction

The use of the internet as an educational support tool is increasingly frequent and its application supports the teaching-learning process. The internet, together with the

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Digital Information and Communication Technologies (DICT), make it possible to create digital documents (DD) [1–3]. The DD, according to the United Nations Educational, Scientific and Cultural Organization (UNESCO) are responsible for the preservation of cultural heritage and defined as cultural constructions and contain views and worldviews for current and future generations [4]. Thus, they enable the dissemination of information and strengthen the construction of knowledge [1–3].

These DD allow a wide production, dissemination and preservation of information and, with the help of DICT, enable the communication between researchers and scientists, especially with regard to the sharing of research results [3, 5–7].

In order to ensure the preservation and access of these DDs, digital repositories (DRs) have emerged, which make it possible to store, organize, manage and access scientific and academic production, manage communities and scientific collections [8].

Institutional digital repositories (IDRs) provide insight into the institution, data interoperability, control and storage of scientific output, long-term information preservation, self-archiving, open access, decreased publication costs [8].

According to Camargo and Vidotti [8]; and Soares [9] or the construction of an RD should be considered navigation requirements, usability and accessibility, searches, disclosure of the environment and customizable services. Therefore, DRs should be evaluated in terms of ergonomics and usability in order to obtain an effective interaction between the user and the material available in an digital repository (DR) and its interface [9, 10]. Among the different tools available to assist in the DR assessment is Possible to evaluate the ease, speed and degree of satisfaction of the users in front of the DR interface [9–11].

Often, its construction was not user-centered, prototyping tests were not performed, so it is important to apply an ergonomic evaluation [12–14], In the Institutional digital repository (IDR) using the inspection techniques and usability tests, with the objective of supporting users in the development of their activities in a productive, intuitive and safe way [15].

Traditionally recognized as a specialized institution in the field of Health Sciences, the Federal University of São Paulo (UNIFESP) was created on December 15, 1994, resulting from the transformation of the Escola Paulista de Medicina (founded on July 15, 1933). It has until that date 6 campuses and 54 courses in the areas of human sciences, exact and biological.

In 2015, the IDR of UNIFESP was implemented as a result of the implementation of a project of the UNIFESP Library Network Coordination (CRBU), the digital repository in the health area of UNIFESP (RDUNIFESP).

2 Theoretical Reference

2.1 Digital Documents (DD)

UNESCO defines DD as cultural constructions and contains world views and visions for current and future generations and is responsible for the preservation of this heritage [4].

The concern with the preservation of DD in Brazilian institutions arose at the beginning of this century, around 2001, with the restructuring of the Technical Chamber of Electronic Documents of the National Council of Archives (CTDE/CONARQ). In 2010, this Technical Chamber published *e-Arq Brasil*, adopted by the National File System (SINAR), which details requirements and fundamental metadata for the development of computerized systems for DD management [16].

DD preservation must be grounded in planning, resource allocation, application of conservation methods and technologies necessary to ensure the original and inherent characteristics of the archival document so that it remains accessible in usable in the long term [17].

In this context, strategies should be applied to preserve these DD to guarantee access, reliability, and integrity of documents [3, 18].

Thus, the creation of a DD preservation policy assumes importance and goes beyond the presentation of only technical and definitive solutions. The DD preservation and management policy must have the ethical commitment to preserve, from public interest criteria, explicit and open for general consultation, documents and their accessibility [4, 17]. This involves information, management and archiving policies of the institution [19].

2.2 Digital Repositories (DR)

With the increase in the production of information in DD format, it becomes important to guarantee its availability and preservation over time. This concern involves both the data producers and the bodies holding this information [3].

In this context the DRs were created, which are informational environments for the storage and management of DD that allow the organization and access of scientific and academic production, the management of scientific communities and collections [20]. These facilitate the implementation of preservation policies and strategies [21].

According to the National Council of Archives (CONARQ) [20], the DR should: manage documents and metadata in accordance with archival practices and standards, specifically related to document management, multi-level archival description and preservation, and protect the characteristics of the archival document, especially authenticity (identity and integrity) and relationship Between documents.

The DR have processes and functions similar to those of digital libraries and also allow the self-archiving and interoperability between various information systems due to the collection of metadata in open files [8].

A reliable digital repository must be able to comply with archival procedures, keep digital materials authentic, preserve them and provide access to them for as long as necessary, and fulfill that mission according to the report "Trusted Digital Repositories: attributes and responsibilities" [20].

An DR can be: Thematic (TDR), when it focuses on a certain area of knowledge or Institutional (IDR), when it is a set of services offered by a certain institution, focused on the dissemination of local scientific production, Research and teaching of academic communities, theses, dissertations, etc.

Regardless of the type, the DRs must be able to organize and retrieve the DDs in order to maintain the organic relationship between them. In this sense, they should

support the hierarchical organization of the DD, based on a classification plan of documents, and the multilevel description, in accordance with the international standard for archival description, the International Standard of Archival Description (ISADG) and the Brazilian Standard Of Archival Description (NOBRADE) [20].

DRs are one of the strategies proposed by the Open Access Movement to promote scientific literature in a freeway and without access costs. The number of institutional and thematic repositories created by the world is increasing. In Brazil, this growth was accelerated by the IBICT-FINEP/PCAL/XBDB project, which enabled the implementation of 40 institutional repositories in several universities and institutions of research. With the dissemination and consequent awareness of the Open Access Movement to scientific information, several Brazilian institutions have been dedicated to the creation of open access digital repositories. The project had its first public announcement launched in 2009 and included 27 institutions, in addition to five of the pilot project. Other edicts have since been launched to assist research institutions and universities in building their own institutional or thematic repositories [22].

Among the advantages of DRs are that they provide visibility for the institution, data interoperability, control and storage of scientific production, long-term preservation of information, self-archiving, free access, reduction of publication costs [8].

2.3 Institutional Digital Repositories (IDRs)

According to Leite [23], Academic institutions around the world use RDI and open access to manage and provide scientific support for scientific information from research and teaching activities. In this sense, they have been intensely used to: improve the internal and external scientific communication of the institution; Maximize the accessibility, use, visibility and impact of the institution's scientific output; Feedback on scientific research activity and support teaching and learning processes; Support the institution's electronic scientific publications; Contribute to the preservation of scientific or academic digital content produced by the institution or its members; Contribute to increasing the prestige of the institution and the researcher; Provide input for the evaluation and monitoring of scientific production; And, to gather, store, organize, recover and disseminate the scientific production of the institution.

Like universities, IDRs are now rated by rankings. Being well positioned in a ranking leads to greater visibility and prestige. This prestige can facilitate the development of the repositories, in terms of internal management and obtaining external resources. The Web of Repositories Ranking is a system of most known rankings today and evaluates the DRs of scientific information. In addition to producing data for measuring and comparing system development, rankings have produced quality indicators that should be considered [24].

Still according to Leite [23], The adoption and effective use of RDI functionalities can result in a number of benefits that are perceived by different segments of the target audience (researchers, academic administrators, librarians, department heads, the university as a whole, the community Scientific, among others).

2.4 Digital Repository in the Health Area of UNIFESP (RDUNIFESP)

In 2015, the IDR of UNIFESP was implemented, resulting from the execution of a project of the Coordination of the Network of Libraries of UNIFESP. It is the digital repository in the health area of UNIFESP (RDUNIFESP), a portal for the storage and access to intellectual production of UNIFESP.

RDUNIFESP is available on the *url:* http://www.repositorio.unifesp.br in Portuguese, English and Spanish. Contains publications from 1939 and until the beginning of 2017, more than 40,000 scientific papers, more than 8400 master's dissertations, more than 6300 doctoral theses are stored and available to access, among other publications such as biographies, letters, editorials, errata, Books and news and allows the search of publications by date, author, title, keyword and communities of UNIFESP.

This IRD uses the DSpace platform (Digital Institutional Repository Building System) that allows the creation of digital repositories with storage functions, management, preservation and visibility of intellectual production, allowing its adoption by other institutions in federated consortium form. The system is customizable and allows the management of scientific production in any type of digital material.

The Fig. 1 below shows the IRD Ranking of Universities in Brazil and those that precede the position of UNIFESP.

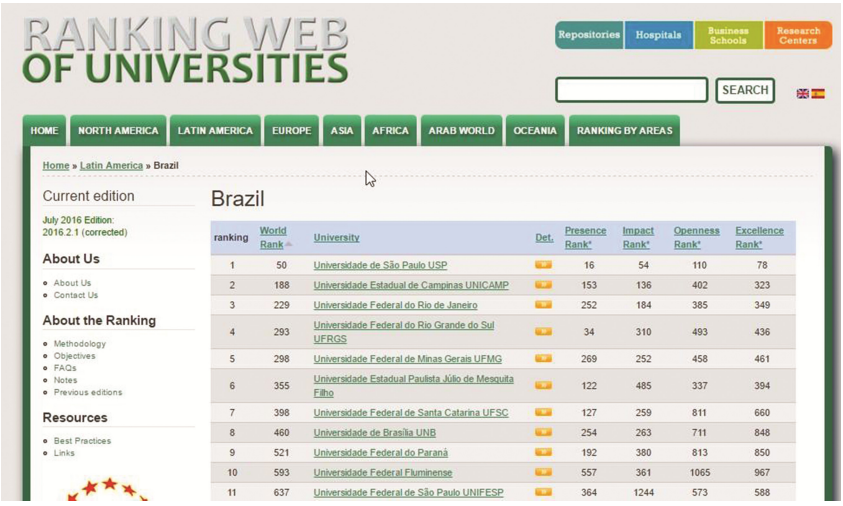

Fig. 1. Ranking of IDR in Universities in Brazil

The Figs. 2, 3 and 4 show the position of RDUNIFESP in the ranking of IDR: in Brazil, America, Latin America, Brincs and worldwide.

Brazil

Ranking	World Ranking	University	Det.	Country	Presence	Impact	Openness	Excellence
11	637	Universidade Federal de São Paulo UNIFESP			364	1244	573	588

Fig. 2. Position of UNIFESP in the IDR ranking of Universities in Brazil

America

Ranking	World Ranking	University	Det.	Country	Presence	Impact	Openness	Excellence
223	637	Universidade Federal de São Paulo UNIFESP			364	1244	573	588

Latin America

Ranking	World Ranking	University	Det.	Country	Presence	Impact	Openness	Excellence
20	637	Universidade Federal de São Paulo UNIFESP			364	1244	573	588

Brics

Ranking	World Ranking	University	Det.	Country	Presence	Impact	Openness	Excellence
65	637	Universidade Federal de São Paulo UNIFESP			364	1244	573	588

Fig. 3. Position of UNIFESP in the IDR ranking of Universities in the Americas, Latin America and BRICS

WORLD RANKING

World Rank	University	Det.	Country	Presence	Impact	Openness	Excellence
637	Universidade Federal de São Paulo UNIFESP			364	1244	573	588

Fig. 4. Position of UNIFESP in the IDR ranking of Universities in the world

2.5 Ergonomics

The term ergonomics means the study of the laws of labor and can be defined as the scientific study of the relationship between man and his means, methods and work spaces, and how senses and motor skills enable people to use machines and tools [9, 25].

Its objective is to elaborate, through the contribution of several scientific disciplines that compose it, a body of knowledge that, from an application perspective, should result in a better adaptation to the human being of the technological means, of the work and life environments [15, 25]. And seeks to reduce or eliminate occupational hazards to health and also improve working conditions, in order to avoid an increase in fatigue caused by the high global workload in its various dimensions: physical load, derived from muscular effort, load Psychic and cognitive load [12].

2.6 Cognitive Ergonomics

With the wide use of computers, the study of ergonomics was expanded to analyze the mental capacity that enables people to produce, retrieve and understand information generated by the DICT and gave rise to cognitive ergonomics [9, 12], And it is concerned with the aspects of the mental activity performed by the user in a given activity and seeks to optimize the effort expended to understand and develop the task, as well as to facilitate the mental process for decision making and execution of a given action [12, 15, 26].

2.7 Mental Load of Work

All elements of the interface should reduce the cognitive and perceptual load of the user, and increase the efficiency of the dialogue. Thus, the greater the mental workload, the greater the likelihood of making mistakes and the fewer actions required, the faster the interactions [9].

2.8 Usability

Interfaces are computational resources that allow the interaction of the user with the system, that is, allow its use in different tasks and its usability is considered a critical factor of success and acceptance of the product by its users [15, 27].

According to Nielsen, usability is a requirement of software quality required and required to achieve the quality of a computer system allowing it to be usable and easy to learn. A system that has good usability rates allows its users to use it in a satisfactory, pleasant and productive way and thus, reaches its goal [13] And its main goal is to ensure that devices and systems are tailored in ways the user thinks, behaves and works, and thus provides usability [12, 15].

There are three standards that specify usability characteristics.

- ISO 9241 defines usability as the ability of an interactive system to offer its user within a specific context of accomplishing their tasks with effectiveness (completeness), and efficiency (better resources) and satisfaction (user well-being) [28].
- ISO/IEC 9126-1 defines the quality of use of a software product used in a context-specific environment and makes it possible to quantify whether user objectives have been achieved in the software environment [29].

- ISO 13047 standard defines a design process and dictates guidelines for the software to be developed focused on the user, facilitating the user's operation and, consequently, a greater usability of the software [30].

An interface that has good usability avoids that its user has to learn complex procedures, helps in memorizing the activities in the system, guides in the exploration of its content, protects against errors and facilitates procedures and reduces the physical and mental load of the user, the time taken to perform a task [12].

2.9 Repositories, Cognitive Ergonomics and Usability

In order to obtain an effective interaction between the user and the material available in an DR, its interface must aggregate usability concepts, which is the quality related to ease of use and learning, and ergonomics, which is the quality of adaptation of An interface to the user profile [5, 8, 9, 14, 17, 21, 26, 31–33].

A high degree of usability of an interface reflects on users performing tasks with ease, speed and satisfaction [10, 12, 13, 15, 26, 31].

Studies carried out in DRs show that they may have gaps such as navigation failures, low usability, limited searches, poor disclosure of the environment, and little or no use of customizable services [5, 8, 17, 21, 34–36].

2.10 Methodologies for Usability Evaluation

The usability evaluation can be performed in two ways: usability testing and usability inspection.

The usability test refers to systematic activities with the objective of verifying how a person or a group of people interact with the application and how it interferes positively or negatively in their activities, i.e., its main intention is to verify the interaction capacity Provided by the user interface [12–14].

These tests enable the evaluator to identify problems of system interaction with the user and, in most cases, with the participation of people directly involved with the use of image and verbalization (Think Aloud) [12, 13]. And are performed in the form of interaction scenarios where the user follows specific and predetermined tasks [31].

The usability inspection refers to activities that aim to verify if an interface conforms to a certain quality standard such as the Ergonomic Criteria of Dominique Scapin and Christian Batien [26] or the Heuristics of Jackob Nielsen [13] and is performed through checklists.

2.11 Population and Sample

It is important and fundamental that the sample intentionally determined by convenience, with the selection of users whose profile contemplates the frequent use of the informational system [37–40].

Besides that, Landauer and Nielsen [41] Show that the number of usability problems encountered (n) in a usability test with users, when evaluating an already developed and deployed information system is:

$$n = N(1 - (1 - L)^N)$$

Where N is the total number of usage problems at creation and L is the proportion of usage problems detected during a single user test. In several studies, these authors found an average L value of 31%. In this context, we have as the determination of the curve of L = 31% the following result in Fig. 5:

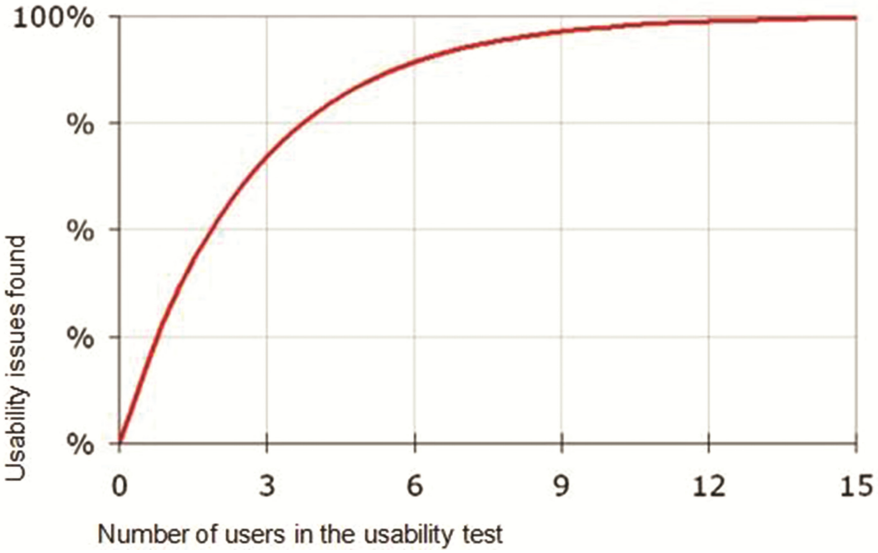

Fig. 5. Usability evaluation according to number of participating users

The first user who performs the usability test shows nearly one-third of the usability issues of the informational system. The second user will display the same information system usability issues encountered by the first user and some other problems.

So, it happens with the third and fourth user and finally we have the fifth user, which makes it reach the mark of finding 100% usability problems of the informational system.

Therefore, the authors of this study recommend that 5 users participate in the evaluation, according to them, this number presents the best cost-benefit ratio, considering users of a group with a single profile [41].

When users of more than one profile category participate in the usability test, 3 users must be chosen for each profile category to ensure coverage of the diversity of behavior within the group [41].

3 Materials and Methods

A qualitative research can be used, with a case study approach to apply usability (predictive) and usability (experimental) and quantitative techniques, also with a case study approach, in the usability test to evaluate The time spent by each user of the sample population to complete each task.

3.1 Apply the Usability Inspection Technique in RDUNIFESP

The step of applying the usability inspection technique in the RDUNIFESP can be performed with the application of the ergonomic inspection checklist, determined from a list of ergonomics criteria, in order to previously analyze the interface of this system and identify points of low Usability in RDUNIFESP to subsidize the next step.

3.2 Apply the Usability Test Technique in RDUNIFESP

The application of the usability test technique in RDUNIFESP is based on the results obtained in the previous subsection. Interaction scenarios are created with tasks to be performed by frequent users of this IDR.

An empirical qualitative research, centered on the user, the evaluation of the experimental analysis is performed on the collection of the data obtained in the observation of users, considering requirements to be fulfilled in the tasks created in the interaction scenarios.

An experimental quantitative evaluation of user observation data collection will be performed as described in ISO 924 [28] On the time taken to complete each task from the screen capture logs.

The quantitative evaluation of the time spent by each user of the sample population to complete each task allows greater precision in the analysis and interpretation of the results, thus trying to increase the confidence margin regarding the inferences of the results found [12–14, 37].

3.3 Identify Points of Suitability and Unsuitability of Usability in RDUNIFESP

The identification and listing of points of suitability and unsuitability of usability in the RDUNIFESP will be accomplished through the qualitative experimental analysis, obtained in the previous subsection.

3.4 Suggest a Set of Specifications and Recommendations for Improving the Usability of IDR

This step to suggest a set of specifications and recommendations for improving the usability of the IDR is performed based on the list of suitability points and usability mismatches obtained in the previous subsection.

4 Contributions

The main technological contributions are the identification and listing of points of adequacy and inadequacy, as well as to suggest a set of specifications and recommendations for improvement of the usability of IDRs.

The main scientific contributions are the dissemination of empirical results with the approach and focus on the usability evaluation, and the creation of a set of specifications and recommendations for the creation and evaluation of IDRs.

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