Analysis of Usability and Information Architecture of the UFRN Institutional Repository

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Abstract. In order to identify the possible problems of usability and information architecture of the institutional repositories, the case study of the Institutional Repository of the Federal University of Rio Grande do Norte was chosen. As research hypothesis, it was established that the information architecture of the UFRN Institutional Repository interface, version 1.8.1, disadvantage usability in performing the tasks by system user groups. Data collection was carried out by applying the techniques of Cooperative Evaluation and Usability Testing of the UFRN/IR system. Problems of usability and information architecture were found in the Institutional Repository from the results obtained. The redesign of the UFRN Institutional Repository interface on areas related to the tasks presented in the research, and considering the aspects of usability and information architecture, mentioned above, we will contribute to access and visibility of information improvement.

Keywords: Design · Information ergonomics · Institutional Repository · Usability · Information architecture

1 Introduction

The amount of generated information becomes difficult to be measured and stored inasmuch as new knowledge arises. Thus, it is proven to be crucial to the countries development due the Internet advent and the disclosure of what is produced, especially between academics.

Therefore, universities have developed tools that allow the disclosure, storage and recovery of produced knowledge, such as digital repositories. According to Viana, Arellano and Shintaku [1] digital repository is "a form of storage for digital files that

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have the ability to maintain and manage it over long periods and to provide its access". Then, the repository fulfills its role of storage, disclosure and preservation of digital documents.

In Brazil, the institutional repositories initiative has began in 2009 when the Brazilian Institute of Information, Science and Technology - IBICT (Instituto Brasileiro de Informação, Ciência e Tecnologia) published the Public Notice FINEP/PCAL/XBDB nº 003/2009, in order to encourage the implementation of repositories and periodicals in Brazilian public institutions of teaching and research. The public notice required, among others, the implantation of the repository system and the inclusion of scientific production of the last five years, within three months, and the team shall be formed by information and computer technicians.

Thus, we questioned if the information architecture and the interface design of the Institutional Repository of the Federal University of Rio Grande do Norte - UFRN, Brazil [2], DSpace software version 1.8.1, would provide interaction with suitable user's groups, achieving the institutional interest of promoting transparency and free access to produced information by the research developed at the university.

As a research hypothesis, it was established that the information architecture of UFRN Institutional Repository system, DSpace software version 1.8.1, discourages the usability when performing tasks by the system user groups.

2 Digital Information Repository

Digital repositories were created in the 90 s, and implemented at Los Alamos laboratory (New Mexico), USA, named virtual repositories (arXiv**) in computing, physics and mathematics areas [3]. Since then, a consensus was agreed among publishers and authors on the importance to provide its open scientific production with unrestricted access, providing large visibility to scientific research.

In 2004, the scientific experts' production of the Brazilian Institute of Information, Science and Technology - IBICT was released in repositories, in which the authors could publish their studies, ensuring open and continuous access to the information. In 2009, the IBICT published a public notice to encourage the implementation of repositories and periodicals in Brazilian public education and research. Thus, the institutions had three months to implement and include their documents helped by a team of information technology technician and librarian. The institutions covered by the public notice received the free DSpace software, version 1.8.1, to manage the repository with the responsibility to customize it.

The Federal University of Rio Grande do Norte - UFRN launched its repository in 2010, being its Institutional Repository RI/UFRN [2] (Fig. 1) responsible for gathering all the intellectual production of the university community (teachers, technicians and post-graduate students) with a mission to storage, preserve and make available on the Internet full texts with free access.

Fig. 1. UFRN institutional repository interface

By the Resolution nº 059/2010-CONSEPE, of April 13, 2010, standards were established on the Institutional Policy of Technical-Scientific Information, in UFRN, regarding your RI, which objectives: manage and disseminate technical-scientific production in digital media and make it visible; and preserve the intellectual memory of the university and serve as a tangible indicator of quality with scientific, economic and social relevance. According to the information policy of RI/UFRN, articles published in journals, complete papers presented at events, dissertations presented in other institutions, electronic books and book chapters were deposited in its collection. Thus, the authors provide to UFRN authorization under the Creative Commons 3.0 Unported license for deposit and disclosure of their documents in digital format.

2.1 Usability and Information Architecture

Usability is the quality that characterizes the use of programs and applications. Thus, it is not an intrinsic quality of a system, but depends on the relationship between its interface and users characteristics to pursue determined objectives in determined situations [4].

For Nielsen [5], the usability is not a single property of a system, but it is associated with 5 quality attributes: (1) Learnability; (2) Efficiency; (3) Memorability; (4) Errors and; (5) Satisfaction.

Shneiderman [6] also set attributes for projects involving graphical interfaces, called “The Eight Golden Rules”: (1) Strive for consistency; (2) Enable to use short-cuts; (3) Offer informative feedback; (4) Design dialogues to yield closure; (5) Prevent errors; (6) Permit easy reversal of actions; (7) Support internal locus of control and; (8) Reduce short-term memory load.

Similarly, Norman [7] establishes 7 principles: (1) Use both knowledge in the world and knowledge in the head; (2) Simplify the structure of tasks; (3) Make things visible; (4) Get the mappings right; (5) Exploit the power of constraints, both natural and artificial; (6) Design for error, and (7) When all else fails, standardize.

To Toub [8], the Information Architecture (IA) is the art and science of structuring and organizing information environments aimed at people effectively fulfilling their information needs. Thus, according to Garrett [9] the IA is a new idea, besides being a practice as old as the human communication. For a long time people had to transmit information and make choices on how to structure it to make other people understand and use them.

It was realized the need to assess the RI/UFRN interface by understanding the institutional repositories importance, and realizing that the interaction with the system presented difficulties, which could be related to the information architecture and usability.

3 Methods and Techniques

The case study of the Institutional Repository of Federal University of Rio Grande do Norte, DSpace software version 1.8.1, was chosen to analyze the usability and information architecture of institutional repositories.

Data collection was performed by applying the Evaluation Cooperative techniques and Usability Testing of RI/UFRN system with a representative group of users (ten librarians, ten graduate students and ten post-graduate students) between February and March of the current year. Despite the teachers also be part of the system user universe, there was no opportunity to include them in the tests.

"Search" and "Submission" of a scientific article was the representative task selected. Besides the evaluation techniques, the participants answered a social-demographic and satisfaction questionnaire adapted from the Questionnaire for User Interaction Satisfaction - QUIS [10] applied after the usability testing.

Usability testing was performed individually, in a computer lab at the university, with the same equipment for all participants, following such configuration: AMD Athlon ™ II X2B22, Processor 2.8 GHz; 2.00 GB RAM; Windows Operating System of 32-bit. The Internet speed was, approximately, 23.8 Mbps for download and 42.28 Mbps for upload. Camtasia Studio software, Trial version, was utilized to analyze user navigation route in the system, allowing recording audio, video and images of screens browsed by the user, thus enabling the detailed analysis of the navigation. The free-license statistical software R, version 3.1.1, was utilized for producing graphs and statistical tests. Five percent (5 %) significance level for statistical tests performance was used in all cases.

The Cooperative Evaluation was performed in a place chosen by the participants. The user interaction and verbalization during the tasks were also recorded by Camtasia Studio software, Trial version.

3.1 Cooperative Assessment and Usability Testing

According to Monk et al. [11], cooperative evaluation is a low-cost technique utilized to identify usability problems in prototype products and processes. The technique encourages design teams and users to collaborate identifying usability problems and possible solutions. Users interact with a prototype in order to realize tasks defined by the design team.

After all, the preliminary results consist of users' comments and evaluation summary, and their experiences observed during the use of the system, allowing the development of recommendations aiming to improve the product.

Dumas and Redish [12] consider the usability testing as a method in which representative participants of a system user group identify problems or validate interface solutions, and this test shall be inserted as part of the project since the initial stage. Therefore, the participants shall represent real users and shall be submitted to typical system tasks.

After Usability Testing, the data was analyzed and the information may confirm the usability of a system or give recommendations for improvements.

4 Analysis and Discussion of Results

Comparing the problems highlighted by users and the usability attributes proposed by Nielsen [5], Shneiderman [6] and Norman [7] is required to identify who was committed during all tasks, as shown in Tables 1 and 2:

Table 1. Comparison among the problems highlighted by users of RI/UFRN, on "Search" task and usability attributes described by Nielsen [5], Shneiderman [6] and Norman [7].

TASK	PROBLEM	Committed attributes		
		Nielsen	**Shneiderman**	**Norman**
SEARCH	Lack of texts standardization on the labels.		Strive for consistency	
	Small font		Strive for consistency	
	Two search fields on the main page are not necessary.		Reduce short-term memory load	Simplify the structure of tasks
	Excessive amount of information on the main page.		Reduce short-term memory load	Simplify the structure of tasks
	The "View/Open" button nomenclature does not indicate if the documents downloadwill be done.	Errors	Prevent errors	Design for error
	The *download* button (View/Open) shall be next to the title.		Strive for consistency	When all else fails, standardize
	"Show Full Registration" option is unnecessary and confusing.	Errors	Prevent errors	Design for error
	The button presenting the access statistics to the document is in English "*View Statistic.*"		Strive for consistency	When all else fails, standardize
	In the results list, the "Preview" field is frustrating because does not present any information.	Satisfaction	Offer informative feedback	When all else fails, standardize
	There is no option to return to the search results list when the user chooses one of them.	Efficiency	Permit easy reversal of actions	Get the mappings right

Table 2. Comparison of the problems highlighted by users of RI/UFRN, in "Submission" task and the usability attributes described by Nielsen [5], Shneiderman [6] and Norman [7].

TASK	PROBLEM	Committed attributes		
		Nielsen	**Shneiderman**	**Norman**
SUBMISSION	The "Personal Area" *login* nomenclature is unclear.	Easelearning	Strive for consistency	Make things visible
	Small font		Strive for consistency	
	Login buttons are widely spaced.		Strive for consistency	When all else fails, standardize
	The options to be selected are unclear in the first step, "Describe" the information.	Learnability	Prevent errors	Design for error
	The submission form is not customized for each document type.	Efficiency	Reduce short-term memory load	Simplify the structure of tasks
	There is no information about success or failure when the actions are performed.		Offer informative feedback	Feedback
	The system does not indicate required fields.	Learnability	Prevent errors	Design for the error
	The introductory texts of the steps are not wording clear.		Offer informative feedback	Feedback
	There is no information procedure for filling the fields.			Simplify the structure of tasks
	The "access Right" button is not available with other disclosure document licenses.	Efficiency	Strive for consistency	When all else fails, standardize
	Form fields are centered on the page.	Satisfaction	Strive for consistency	
	The "Cancel/Save" button indicates ambiguous action, which shall be separated, leading the user to cancel the submission performed.	Errors	Prevent errors	Design for error
	When you select to add more fields, to include other authors and keywords, the system adds two fields at a time.		Strive for consistency	
	In "load" step, the system does not report if the document was attached to the system.		Design dialogues to yield closure	Feedback

(Continued)

Table 2. *(Continued)*

TASK	PROBLEM	Committed attributes		
		Nielsen	**Shneiderman**	**Norman**
	In "load" step, the information "Show *checksums*" is confusing and unnecessary.			When all else fails, standardize
	The help information is available in English.	Learnability	Strive for consistency	
	The help information appears in *pop-up* format, which may be blocked in some computers.	Efficiency		
	In "Check" button, the system does not return to this field when a correction of some information is required.	Efficiency	Shortcuts for heavy users	
	Some labels and information are presented in English.	Learnability	Strive for consistency	
	There is no explanation on the *Creative Commons* license.	Learnability		
	After selected the *Creative Commons* license, the "Continue" button appears in small font and in *link* format, inducing the user to select "Skip *Creative Commons*" to continue the submission.		Strive for consistency	
	The disclosure license text is available in English.	Learnability	Strive for consistency	
	In "Complete"buttom, the last task, show the return fields to "My Space" and "Communities and Collections" as links, which induces the user to select "*Submit another item to the same collection*"		Strive for consistency	

It was observed that, according to the authors, some usability attributes were committed during the tasks performance as: Feedback, Consistency, Learnability, among others. Thus, these attributes shall be considered for future redesign projects of RI/UFRN interface.

4.1 Application of Severity Level

According to Nielsen [13], severity of a usability problem is a combination of 3 factors: (1) the frequency with which the problem occurs; (2) the impact of the problem for users (difficult or easy to overcome) and (3) the persistence of the problem (is it a one-time problem that users can overcome once they know about it or will users repeatedly be bothered by the problem?). He also proposes a classification scale to achieve an overall assessment of each usability problem, in order to facilitate the prioritization and decision-making.

Severity	Description
0	I do not agree that this is a usability problem at all
1	Cosmetic problem only: need not be fixed unless extra time is available on project
2	Minor usability problem: fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority
4	Usability catastrophe: imperative to fix this before product can be released

Fig. 2. Nielsen's usability problems severity level

Thus, after the evaluations and problems comparison highlighted individually by the users, with the usability attributes committed, its severity levels were attributed to the "Search" task (Table 3) and "Submission" task (Table 4) (Fig. 2).

Table 3. Severity Levels Application in errors identified in Search Task of RI/UFRN

TASK	PROBLEM	SEVERITY				
		0	1	2	3	4
SEARCH	Lack of texts standardization on the labels		X			
	Small font		X			
	Two search fields on the main page are not necessary			X		
	Excessive amount of information on the main page			X		
	The "View/Open" button nomenclature does not indicate if document *download* will be done	X				
	The *download* button (View/Open) shall be next to the title		X			
	"Show Full Registration" option is unnecessary and confusing				X	
	The button presenting the access statistics to the document is in English "*View Statistic*"				X	
	In the results list, the "Preview" field is frustrating because does not present any information.				X	
	There is no option to return to the search results list when the user chooses one of them.			X		

Table 4. Severity Levels Application in errors identified in Submission Task of RI/UFRN

TASK	PROBLEM	SEVERITY				
		0	1	2	3	4
SUBMISSION	The "Personal Area" *login* nomenclature is unclear		X			
	Small font			X		
	Login buttons are widely spaced			X		
	The options to be selected are unclear in the first step, "Describe" the information				X	
	The submission form is not customized for each document type				X	
	There is no information about success or failure when the actions are performed			X		
	The system does not indicate the required fields				X	
	The introductory texts of the steps are not wording clear			X		
	There is no information procedure for filling the fields				X	
	The "access Right" field is not available with other disclosure document licenses			X		
	Form fields are centered on the page		X			
	The "Cancel/Save" button indicates ambiguous action, which shall be separated, leading the user to cancel the submission performed					X
	When you select to add more fields, to include other authors and keywords, the system adds two fields at a time			X		
	In "load" field, the system does not report if the document was attached to the system				X	
	In "load" field, the information "Show *checksums*" is confusing and unnecessary			X		
	The help information is available in English				X	
	The help information appears in *pop-up* format, which may be blocked in some computers				X	
	In "Check" step, the system does not return to this step when a correction of some information is required			X		
	Some labels and information are presented in English				X	
	There is no explanation on the *Creative Commons* license			X		
	After selected the *Creative Commons* license, the "Continue" button appears in small font and in *link* format, inducing the user to select "Skip *Creative Commons*" to continue the submission.				X	
	The disclosure license text is available in English				X	
	In "Complete" bottom, the last task, show the return fields to "My Space" and "Communities and Collections" as links, which induces the user to select "*Submit another item to the same collection*"				X	

5 Recommendations

A list of design recommendations was elaborated for RI/UFRN from the obtained results analysis during the research, in areas of tasks as documents "Search" and "Submission" (Fig. 3). The recommendations list was organized by solving priority of the problems highlighted by the severity levels.

RECOMMENDATIONS LIST
High Resolution Priority
• Separate the options Cancel and Save found in the submission form, to avoid the submission induction exclusion started by the user.
Medium Resolution Priority
• Perform a revision throughout the layout and labeling/terminology text to make them simple, clear and consistent.
• Remove information from the page that is not necessary for the user.
• Customize the submission form according to the document type.
• Provide confirmation to the tasks performed by the user.
• Translate the labels and available texts in the system to Portuguese.
• Highlight important information and commands to perform the task.
• Highlight form fields that are filling required.
Low Resolution Priority
• Use text and fields of the form aligned on the left.
• Collect the access permissions and licenses in a single space.
• Provide more information about the *Creative Commons* license
• Limit the inclusion of additional fields in the form to one at a time.

Fig. 3. Recommendations List of RI/UFRN

The implementation of these recommendations, based on collected information from users, could help to develop a more efficient and satisfactory interface, favoring the system usability in tasks as "Search" and "Submission".

6 Conclusion

Usability problems and information architecture present in the Institutional Repository system, such as labeling, size of source, buttons nomenclature, lack of system feedback, were found in the obtained results through the Cooperative Evaluation with post-graduate students and Usability Testing with graduate students and librarians. The participants would be unsatisfied with the problems and undermine their perception regarding the safety, as occurred with the post-graduate students.

Thus, the generated hypothesis at the beginning was confirmed, as the "information architecture of UFRN Institutional Repository system discourages the usability in tasks performing by the system user groups".

Despite this, the participants consider the institutional repository a significant value tool, since it allows free access to scientific publications and research developed by IES.

Finally, the UFRN Institutional Repository interface redesign for "Search" and "Submission" tasks, will consider the usability aspects and information architecture mentioned above, and will contribute for a change in access and information visibility [14], as well as promote a centered approach on the user, according to Santa Rosa [15], all based on the proposed amendment recommendations of this study. Additionally, the valuation techniques application is recommended to other tasks, which the repository users are submitted, in order to complete the study for the whole system.

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