Developing imaged KOS with the FRSAD model: a conceptual methodology

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Abstract

This proposal presents the methodology of indexing with images suggested by De Brito and Caribé (2015). The *imagetic* model is used as a compatible mechanism with FRSAD for a global information share and use of subject data, both within the library sector and beyond. The conceptual model of *imagetic* indexing shows how images are related to topics and 'key-images' are interpreted as *nomens* to implement the FRSAD model. Indexing with images consists of using images instead of key-words or descriptors, to represent and organize information. Implementing the imaged navigation in OPACs denotes multiple advantages derived from this rethinking the OPAC anew, since we are looking forward to sharing concepts within the subject authority data. Images, carrying linguistic objects, permeate inter-social and cultural concepts. In practice it includes translated metadata, symmetrical multilingual thesaurus, or any traditional indexing tools. iOPAC embodies efforts focused on conceptual levels as expected from librarians. Imaged interfaces are more intuitive since users do not need specific training for information retrieval, offering easier comprehension of indexing codes, larger conceptual portability of descriptors (as images), and a better interoperability between discourse codes and indexing competences affecting positively social and cultural interoperability. The *imagetic* methodology deploys R&D fields for more suitable interfaces taking into consideration users with specific needs such as deafness and illiteracy. This methodology arouse questions about the paradigms of the primacy of orality in information systems and pave the way to a legitimacy of multiple perspectives in document indexing by suggesting a more universal communication system based on images. Interdisciplinarity in neurosciences, linguistics and information sciences would be desirable competencies for further investigations about he nature of cognitive processes in information organization and classification while developing assistive KOS for individuals with communication problems, such autism and deafness.

Keywords: Knowledge representation; Semiotics; Indexing with images; Imaged OPACs; FRSAD; Social interoperability

1. Introduction

Digital libraries (DL) concept is evolving to an innovative understanding of institutions from a virtual realm that embodies in priority library concepts rather then technological apparatus, DL are intentionally closer to its users despite being at distance whilst adhering to principles of quality in services. That means DL is a set of characteristics identifying documentary organizations attempting to "associate immaterial with material (for example the OPAC[1]), local with distant (open/close/semi-open client-server architecture) and visible with invisible (semantic data on the bibliographical notes)" (Papy, 2016, 13).

The power of digitization causes scientific, educational, economic and cultural communities to change their modes of accessing, sharing and disseminating knowledge. Besides, complexity and uncertainty from compulsive modernisation drive people to rely on information to perform their professional activities or to simply exercise their citizenship. In this social flow, the world became a great consumer of images because they are more effective in mass communication than written-only documents (Social Bakers, 2014; Asthon, 2015).

Semiotics shows that image is a communication language and people have natural competencies to assimilate linguistic properties from images to engage in a communication process, which corroborates with prior linguistic theories. In fact, the grammar codes that govern imaged communication are easily understood by a larger public, although structurally more complex and less explicit.

Indexing with images consists of using images instead of key-words or descriptors, to represent and organize information. Profundity in discourse is a characteristics of the written language, yet its representation is only possible with elements of cognition. It is a complex process to make use of words to represent knowledge. Yet, text contents have been embodied by textual elements themselves. Admitting the multidimensional characteristics of images to broadcast messages, this work proposes a different point of view in the communication perspective. It certainly means a shift in knowledge organization systems (KOS) and leads towards the achievement of social and cultural interoperability as defined by Mustafa El Hadi (2015).

For example, in terms of knowledge organisation, the brain of a born deaf individual (Marschark et al., 2000; Mcevoy et al., 2004) does not create the same connexions as hearing individuals. They generate alternative logical networks to understand and interact with the textual (oral and written) society. However, concerning the pervasive imaged world, deaf people attest far more awareness of images than hearing people. These observations lead to significant understandings of image perceptions. Evidences are that accuracy in identification of image details is related to the ability of decoding imaged messages. Because messages are codes, frequently converted to textual systems, the decoding methods for imaged messages are the key for interoperability between written and imaged communication. Regardless of the predominant competence of deaf people in recognising images, our society still cannot give them the freedom to evolve independently in our written world. There is potentially a bridge

[1] Online Public Access Catalog

[2] Work presented at ISKO-BRAZIL CONFERENCE (2015)

[3] Latin, boundary marker, limit — more at term. First Known Use: circa 1617. Source: Merriam-Webster's Learner's Dictionary

[4] Nieuwenhuysen, P. (2013). Search by Image through the WWW: an additional tool for information

connecting messages from these distinct universes, establishing an authentic two-way communication process.

What hinders semantic and consequently cultural interoperability is that the degree of success that can be achieved in the integration of multiple knowledge representation systems or knowledge organization schemes is constrained by limitations of the universality of human conceptual systems. In contrast, considering that images are powerful communication tools, imaged KOS are potentially valuable "intercultural" interfaces for semantic interoperability which is one of the core elements towards cultural interoperability. In this sense, we support the idea that imaged KOS support translatability and additionally promote navigation within social and cultural diversity through their iconic interfaces. We will develop in the following sections the concept of the imaged online public catalogue (iOPAC)[2] as a KOS for accessibility in libraries, archives and museums.

To go further in developing the imaged KOS we will consider implementing it as a user-focused mechanism compatible with FRSAD (Functional Requirements for Subject Authority Data). FRSAD supports the idea that a work has subject(s) (*thema*), and a *thema* has one or more appellations *nomen*. While associated with topics, images can be interpreted as *nomens* within the FRSAD conceptual model.

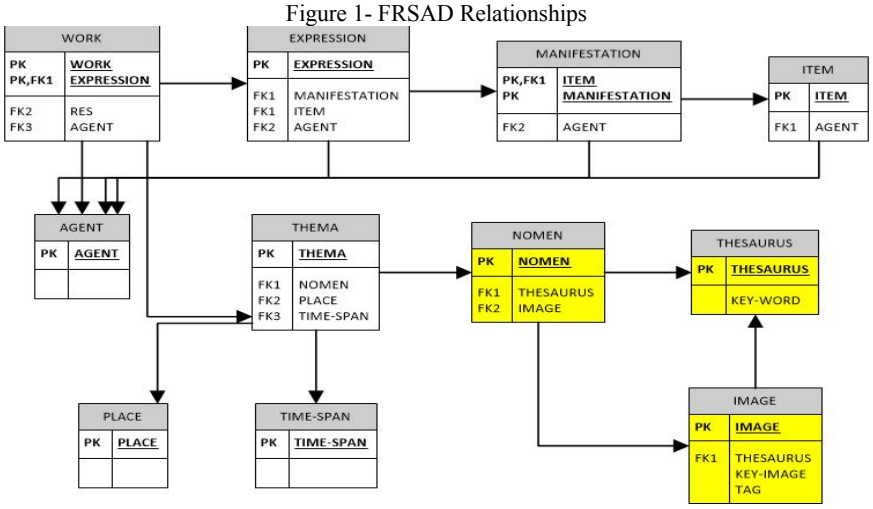
2. Functional Requirements for Subject Authority Data (FRSAD)

IFLA proposed in 2010 a new bibliographic infrastructure to support global sharing and reuse of subject authority data, the FRSAD model. Aboutness is the FRSAD focus to provide a clearly defined, structured frame of reference for relating the data that are recorded in subject records. Žumer, Zeng and Salaba (2012), show how this structure is tailored to meet the needs of the users of these records and to assist in an assessment of the potential need for a global information share and use of subject data both within the library sector and beyond.

In FRSAD model a work has subject(s) *thema*, and a *thema* has appellation(s) *nomen*. *Nomen* is any sign or combination of signs (images inclusive). FRSAD presents four subject authority data user tasks. To *find* an entity (*thema* or *nomen*) or set of entities corresponding to stated criteria. To *identify* an entity (*thema* or *nomen*) based on certain attributes or characteristics. To *select* an entity (*thema* or *nomen*). And to *explore* any relationships between entities (*thema* or *nomen*), correlations to other subject vocabularies and structure of a subject domain. A *nomen* can be human-readable or machine-readable.

[2] Work presented at ISKO-BRAZIL CONFERENCE (2015)

Figure 1- FRSAD Relationships



Source: adapted from Riva and Žumer (2015)

FRSAD Entity-Relationship conceptual model (Riva and Žumer, 2015; Zeng, Žumer and Salaba 2011,15) postulates that "has appellation/ is appellation of" relationship is in general many-to-many. A *thema* has one or more *nomens* and there may be a *nomen* referring to more than one *thema*. In addition the diagram above shows how *nomens* are related to images (key-image descriptors) and traditional relationships with thesaurus. Images can be tagged with entries from thesaurus (Gheorghita, 2011, Aitchison and Clarke, 2004) or with external social tags, such as from folksonomies.

As a result the relational model illustrates that *key-images* (tailored made) are tagged as well as original images explaining inheritance from concepts embedded in images, what ensures wider semantic fields for imaged descriptors and sense integrity throughout the indexing process. Moreover, the same integrity improves KOS functions and information retrieval quality in interoperability perspectives.

By following interoperable web design principles, such as the use of RDF and XML, this proposal sought to create an *imagetic* model that could be integrated into an OPAC system potentially supporting a variety of uses, including query expansion in search, resolving ambiguous subject use in resources, and promoting serendipitous discovery of new links among and between documents. In short, to access, convert, or reuse web content from a variety of domain-specific and general resources.

3. The underlying semiotic contribution

In practice, indexing as it is known is a translation of lexical units drawn from language, or a syntactic translation reflecting the relationships between parts of the speech, the ones describing content, the descriptors. It aims to represent the objects (concepts) that the document is talking about, or in other words, what is said in the speaker's message. Although words are used to index content, the words from a natural language or from dictionary (morphemes) point only to their signifiers, not to referents. They do not have these characteristics of designing objects.

Words in terminology[3] introduce a notion of a boundary or "terminus" in Latin that gave the word "term". The French linguist Michel Le Guern (1989) explains that in the lexicon as in terminology there are words on both sides, but they are not the same words. The object "word" from the lexicon is a distinct reality, the lexicon processes words disconnected from the objects, while in terminology the words are connected to things. Words in lexicography are considered to be nouns but in reality they are predicates. They talk about qualities, not about substances; they refer to proprieties, not to substances; to qualities, not to objects. The presence of an object calls for a term to be admitted into the discourse.

For a long time the advantages of using images to transmit and receive messages have been investigated in semiotics. Advances on information technologies encourage important considerations about the information media. Literacy is essential, nonetheless we all read differently. The registered information is not only obtained from text, image has (re)conquered its place in communication. Interpreting imaged signs is as to reopen the gates of ancient temples reading stories trough cultures and ages.

In his pragmatism and logic, Charles Sanders Peirce (1839-1914) assumed that there is no immediate (without signs) perception of reality, so in the perception process everything is a sign including thoughts (Nöth, 2012). He claims that a sign consists of three elements, one of them is the sign, the second is an object to which a sign refers and the third, the most significant, is an interpretant (Lefebvre, 2007). In its simplified triad form of icon, index and symbol, Peirce's logic explains that an icon represents an acquired experience from the past, a reminder from that experience, a portrait of a concluded moment. An index apprehends its experience from the present, it points to a thing, without giving any information about it. The symbol is the real fact that will be experimented in the future, at the very moment when the message arrives to the receiver and the formulated intensions are to be re-established.

For Peirce, language and image compose the signs whose functions are embedded in the relations between the icon, the index and the symbol. When the roles of those signs are in balance, there is fulfilment. Peirce's theory is largely employed for image description purposes and in archival practices. The focus is on the description of an 'image-document' for further retrieval.

Instead of describing images, we are interested in using them as a sign, replacing key-words with images for content representation. This imaged representation presupposes a different navigation approach for the KOS and a subjacent (lying under or below Peirce's theory) theory to support the whole. For Peirce each object is in relation with a number of other objects from the same universe, directly or indirectly, in such a path that each element carries within itself an undetermined indicial potential. How then a sign can represent an object and reveal it itself? The iconic representation is a quality that emerges from the object in order to identify it as it is. Signs leading to inferences over true realities are the ones that make possible indexing with images principles as explained by De Brito and Caribé (2015).

The emerging 'key-image' concept means substitution or equivalence with the key-word concept commonly used to describe subject contents. The procedure of intentional construction of images of this model is inspired from Jacques Bertin's (*apud* Dantier, 2008; Bertin, 1970) works in which he demonstrates that image composition follows the rules of linguistic semiotic. For this author, every thought is

[3] Latin, boundary marker, limit — more at term. First Known Use: circa 1617. Source: Merriam-Webster's Learner's Dictionary

expressed throughout a system of signs imitating a natural codification. The verbal language is a code of audible signs, the writings of a language are another kind of code, and so it is a graphic representation. So, if a graphic representation is a transcription of information from a graphic system of signs, then it has to be considered semiotic matter.

For Bertin (1970) a graphic representation might have three basic functions: register, communicate and process information. Indexing with images anticipates a moment of lecture and another of creation. It results in building an image (a chart) able to communicate a thematic message corresponding to the document's contents. In comparison to the key-words, the result of indexing with images is not a simple selection of images subjacent one to another, but a chart of significative images intentionally composed to become the key-image of the document. These indexing images are made of a set of iconic, indicial and symbolic proprieties (transmitted or inherited) to represent the document. This new composed image, gathering multiple semiotic traits, has itself a new symbolic interpretation.

4. The imaged KOS

The KOS we describe here is not an OPAC but a model for indexing by images to support an OPAC based on a semiotic approach. Designing OPACs, using the imaged indexing initiative, will involve not only IT solutions but also giving answers to epistemological questions inherent to the nature of images. The procedure of using images to describe documents is not free of impacts. Besides, Papy (2016, 57) reminds us that it is imperative to meet the users' needs by rethinking the design of devices and stopping privileging the technological orientation.

Structurally, while looking for a specific document using the iOPAC interface, at user's behaviour first tends to recognize the conceptual relationship between images and objects (image-subject/document-subject), then he uses this cognitive mechanism to find the object (a document) or set of objects he is looking for. In another case, at user has an information need, but ignores that there is an object (or a set of objects) that could respond to his demand. He tries first to match needs to images, and then to verify inside the collection of documents if there are connexions of some kind, repeating the first case above.

Implementing the imaged navigation in OPACs denotes multiple advantages derived from this. The iOPAC has a greater visual attraction pushing users towards the catalogue; a more intuitive comprehension of indexing codes, a larger conceptual portability of descriptors (as images), and better interoperability between discourse codes and indexing competences affecting positively social and cultural interoperability.

Applying the imaged concept to *nomen* in the FRSAD model is rethinking the catalogue anew, since we are looking forward to sharing concepts within the subject authority data. This happens when images, carrying linguistic objects, permeate inter-social and cultural concepts. In practice it includes translated metadata, symmetrical multilingual thesaurus, or any traditional indexing tools.

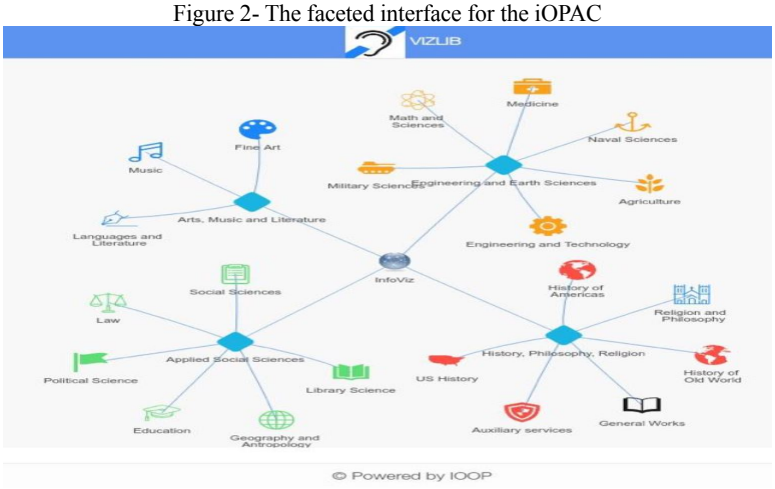
Thinking interfaces for the iOPAC at our ongoing project, the preliminary proposal (Figure 2) is designed for interoperability and portability devices. In the graphic interface, the user's query progress in a faceted hierarchic sequence of images choices. The cascade navigation rolls down to sub-classes inside the catalogue until reaching the

most profound hierarchical level, the one in which the user finds the wanted documents.

The undertaking implementation shown in Figure 2, intends to connect the thesaurus to the indexing methodology of key-image. It is thought to be a hierarchical navigation throughout classes of a given classification instrument (Dewey Classification, for example), each level associated to sets of representative key-images of the library resources. In that way the navigation is faceted because it evolves horizontally between choices of classes and vertically among subclasses. Each level of subsequent prospection is assisted by sets of key-images to refine the documentary retrieval process.

The navigation interface (Figure 2) also uses images (Library of Congress cataloguing icons, Figure 3) instead of the common written or numeric representation to prepare the users to the imaged representation of resources and the imaged retrieval method of matching images to contents. From the experience of teaching deaf people in photographic communication, they need to be coached while learning or dealing with our common social codes (Gurgel, De Brito and Silva, 2016), in that way we expect that LCC icons will guide the users to become more confident while exploiting the imaged retrieval system.

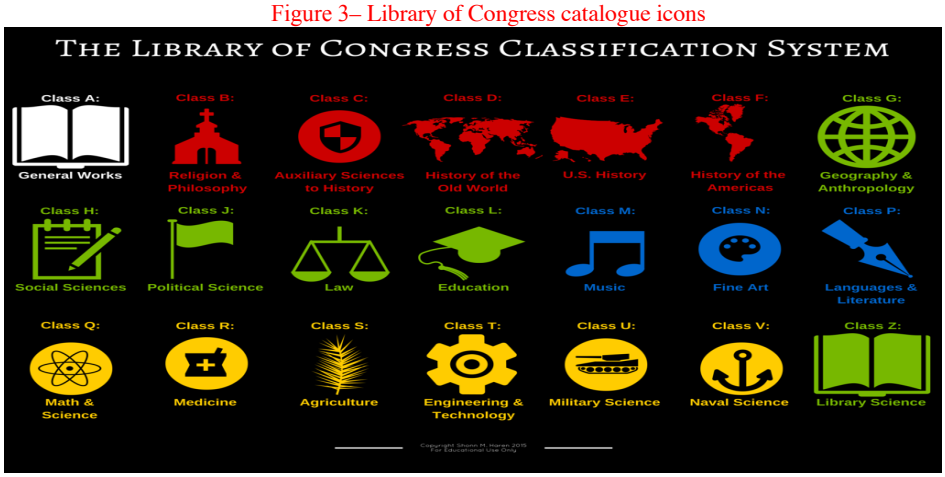
Figure 2- The faceted interface for the iOPAC



The facet display represents personal and corporate images, geographic maps, time periods, topics and others. The facet defines the interest domains; the navigation progresses by examining representative domain material or collecting images that reflect domain interests, then sorting images into homogeneous, mutually exclusive groupings (facets). Facets are structured in hierarchical order to coalesce synonyms, identify misaligned signs and gaps in the system.

The Library of Congress Subject Headings has been assigned to a simplified list of signs making the classification schema easier for users to understand, apply, and reuse. Any valid set of Library of Congress' icons (Figure 3) can be converted to subject headings. The great advantage on using LCC icons, for example, is that the image set is homogeneous and intended to be intuitive.

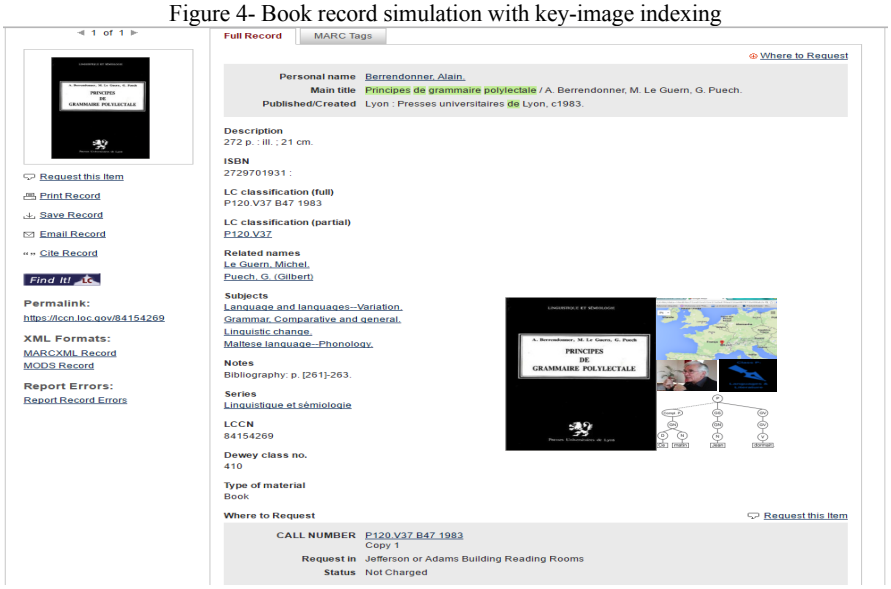
Figure 3– Library of Congress catalogue icons



https://commons.wikimedia.org/wiki/File:The_Library_of_Congress_Classification_System.png

As shown in Figure 4, a book could be located using a traditional (written) query or an imaged one. In both cases the search would be naturally improved by the iconographic support of the key-image, meaning references to the book cover, to France, to tree grammar representations, and to the authors' image, all references absent in the document description as shown below.

Figure 4- Book record simulation with key-image indexing



Source: Simulation study on Library of Congress' OPAC response (https://catalog.loc.gov/index.html)

The iOPAC embodies efforts focused on conceptual levels as expected from librarians. Also, model implementations have encountered challenges during its validation regarding methodology of mapping concepts in images or establishing conceptual relationships among subjects and classification systems. The prototype of a beta system is to be developed to test the model.

Research projects such as Nieuwenhuysen (2013, 2015) in which a query does not consist of text but of an image file[45] or that of Ménard (2009) could also give a larger conceptual portability of descriptors (as images). It sought to identify the differences from the terminological, perceptual and structural points of view, in a multilingual environment, between indexing a set of images representing objects using either a controlled vocabulary or a free or uncontrolled vocabulary approach. Yet, these are nothing but imminent issues for future research.

The digital document in digital libraries, reminded Papy (2016, 103-104) introduces combinatorial diversity of the content, redefines the relationship between content and usage. "The form – the presentation which cannot simply be reduced to the page setting or the formatting of the characters – carries with it a diverse set of usage semiotic values".

As Papy (2016) observed, the flexibility of the interoperability of Web applications borne by XML technologies and generalization of dynamic web, the possibilities of adapting the final form of an XML document, building it or transforming it are, essentially limitless. Personalized virtual documents (PVDs) which are largely composed of all kinds of fragments, extracted from different information systems, possibly hosted on distant machines, have no predefined size or form. "Digital libraries lend themselves to the extraction of such fragments: a video resource extracted from an AV resource portal can be integrated into a resource with articles from different reviews portals and bibliographical elements from online catalogs" (Papy, 2016, 93).

5. Final considerations

Indexing with images brings us to reconsider the current paradigms about using key-words to describe document contents. The key-images announce a legitimate approach to index documents with multiple perspectives in technical, professional and social areas. We can perceive changes in documentary retrieval fields, when enhanced with universal KOS based on imaged communication, and no longer contained by a specific written language. This contribution to knowledge representation is supported by semiotic theories and presents a new approach for documentation which needs to be tested in large scale of documents and users.

Web search engines may use these alternatives of indexing techniques to support KOS performance. A broader area for interface development is now available with effective benefices for handicapped users, such as deaf people, groups with functional illiteracy in general or in the sense of multicultural interoperability. In short, the use of

[4] Nieuwenhuysen, P. (2013). Search by Image through the WWW: an additional tool for information retrieval. In full text published in proceedings of the international conference on Asia-Pacific Library and Information Education and Practices= A-LIEP (p. 38).

[5] Nieuwenhuysen, Paul (2015) Search by Image Through the Internet: An Additional Method to Find Information. In: International Conference on Libraries (ICOL) 2015, 25-26 August 2015, Vistana Hotel, Pulau Pinang.

images to create bonds between people and documents meet KOS challenges in a prosperous scientific ground.

The Imaged model, in addition, can be implemented as a user-focused mechanism compatible with FRSAD. We believe that the Imaged methodology can offer new possibilities for considering semantic and cultural interoperability when using OPACs. The iOPAC is proposed as a product, a service, an interface and also an assistive technology for social interoperability. The iOPAC is our ongoing project that a future prototype beta system is to be tested.

6. References

AITCHISON, Jean and CLARKE, Stella Dextre (2004). The Thesaurus: A Historical Viewpoint, with a Look to the Future, *Cataloging & Classification Quarterly*, *Vol. 37, N°. 3/4 2004, pp. 5-22*.

ASTHON, Danny (2015). *10 reasons why you should care about visual content marketing*. Blog. Publicado em 19 de fevereiro, 2015. Disponível em: <http://neomam.com/blog/13reasons/>. Accessed : May 2015.

BERTIN, Jacques (1970). La graphique. *Communications,* v. 15, n. 1, p. 169–185.

CARIBÉ, Rita de C.V and DE BRITO, Marcílio (2015). Indexação por imagens: via OPACs imagéticos. In: III *Congresso Brasileiro de Organização e Representação do Conhecimento.* Marília - SP: ISKO-Brasil. p. 425-448.

DANTIER, Bernard (2008). La représentation et l'étude visuelles des informations. In.: BERTIN, Jacques. *Semiologie graphique, les diagrammes, les reseaux, les cartes.* 4.ed. Paris. Ehess, 32 p.

DE BRITO, Marcílio and CARIBÉ, Rita de C.V (2015). Princípios da indexação por imagens. In: XVI *Encontro Nacional de Pesquisa em Ciência da Informação* (XVI ENANCIB), João Pessoa p. 1-2

GEMBERLING, Ted (2016). FRSAD, Semiotics, and FRBR-LRM. *Cataloging & Classification Quarterly* 54, no. 2: 136. Publisher Provided Full Text Searching File,

GHEORGHITA, Inga (2011). Methodologie de construction automatique du thesaurus pour l'indexation et la recherche des images. *RECITAL,* n. 2, p. 221–228, Jun. Disponível em: <https://hal.archives-ouvertes.fr/hal-00695722>. Accessed : May 2015.

GURGEL, I.; DE BRITO, M. ; SILVA, R. C. J. (2016). Projeto tecnológico e sustentável de inclusão social: Rede de bibliotecas com acessibilidade para estudantes surdos In: *I Congresso Internacional de Educação Especial e Inclusiva,* 2016. Marília - SP. I CIEEI & XIII JEE 18 a 20 de Maio de 2016 - Marília - São Paulo. Marília - SP: Fundepe.

IFLA (2000). *Guidelines for Library Services to Deaf People*. 2nd edition. Hague: IFLA

LE GUERN, Michel (1989). Sur les relations entre terminologie e lexique. *META Journal de traducteurs.* Montréal.

LEFEBVRE, Martin (2007). The art of pointing: on Peirce, indexicality, and photographic images. *Photography Theory*, p. 220-244.

MARSCHARK, M; GREEN, V; HINDMARSH, G; WALKER, S. (2000). Understanding theory of mind in children who are deaf. *Journal of Child Psychology and Psychiatry* 41 (08), 1067-1073.

MCEVOY, C; CONVERTINO, C; MASTELLER, A; MARSCHARK, M (2004). Organization and use of the mental lexicon by deaf and hearing individuals. *American Annals of the Deaf,* 149 (1), 51-61

MÉNARD, Elaine (2009). Images: indexing for accessibility in a multi-lingual environment -- challenges and perspectives. *Indexer,* Jun 27(2), 70-76.

MUSTAFA EL HADI, Widad (2015). *Cultural Interoperability and Knowledge Organization Systems*. Keynote address, University of St Paulo at Marilia, Brazil, Proceedings of the 3rd Brazilian ISKO-Conference.

NIEUWENHUYSEN, P. (2013). Search by Image through the WWW: an additional tool for information retrieval. In: *The international conference on Asia-Pacific Library and Information Education and Practices A-LIEP* (p. 38).

NIEUWENHUYSEN, Paul (2015) Search by Image Through the Internet: An Additional Method to Find Information. In: *International Conference on Libraries (ICOL)* 2015, 25-26 August 2015, Pulau Penang. Malaysia.

NÖTH, Winfried (2012). Charles S. Peirce's theory of information: a theory of the growth of symbols and of knowledge. *Cybern. Hum. Knowing* 19 (1e2), 137 e 161.

PAPY, Fabrice (2016). *Digital libraries: interoperability and uses*. Oxford: Elsevier. 146p.

RIVA, P. and ŽUMER, M (2015). *Introducing the FRBR Library Reference Model*. In: IFLA WLIC 2015 - Cape Town, South Africa in Session 207 - Cataloguing. 7p.

SOCIAL BAKERS (2014). *Photos cluttering your facebook feed? here's why pictures account for majority of brand facebook posts.* April 21. Advertising & Marketing. Available at: <http://www.emarketer.com/Article/Photos-Cluttering-Your-Facebook-Feed-Herersquos-Why/1010777/1> Accessed : May 2015.

TUFTE, Edward R (1998). *Envisioning information*. Connecticut, USA: Graphics Press. 126 p.

ZENG, Marcia Lei, Žumer, Maja and Salaba, Athena. (2011). *Functional requirements for subject authority data (FRSAD): a conceptual model*. Berlin: De Gruyter Saur.

ŽUMER, Maja; SALABA, Athena and ZENG, Marcia Lei (2007). Functional Requirements for Subject Authority Records (FRSAR): A Conceptual Model of Aboutness. In: *Proceedings of the 10th International Conference on Asian Digital Libraries (ICADL*), Hanoi, Vietnam, December 10-13, 2007. (Lecture Notes in Computer Science Series, Volume 4822: 487-492) Berlin: Springer.

ŽUMER, Maja; ZENG, Marcia Lei and SALABA, Athena (2012) FRSAD: Conceptual Modeling of Aboutness. Third Millennium Cataloguing. Santa Barbara: Libraries Unlimited.