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Document representation with images: an experimental milestone

Abstract
Our previous research considered a document management system (DMS) interface from the perspective of an iOPAC (imaged OPAC) to meet the needs of a digitally adapted indexing process. The proposed indexing methodology makes use of a document/‘key-image’ correspondence in the user-system communication process, adopting the IFLA-LRM model. The present study intends to validate this conceptual model by establishing an experimental protocol. Using the same scope and methodology, the experiment was first applied to a group of deaf students and subsequently to a group of librarianship students, so as to contrast data and determine the interoperability variable. Confirming the working hypothesis, fifty-three per cent of the deaf population and eighty-eight per cent of the librarianship students recognised the relationship between a document and its ‘key-image’ while also considering it an easy and intuitive method.

1. Introduction
Images play a crucial role in knowledge organization systems and media applications in general (Sousanis 2015). Photography and cinema underwent an extraordinary development in the early twentieth century. At that time, Paul Otlet (1934, 224) discussed the sense of sight, whose field of exploration is broader than that of any other sense. Film, he says, acts on the brain even more directly than theatre, because it removes the effort of interpreting written and spoken language and concentrates emotion, by viewing things immediately. For Otlet, there has been a shortcut from reading or illiteracy, to cinema, since it is easier to see than to hear or even perceive language by its sounds.

An indexing model based on images requires reconsidering the current paradigm of using exclusively keywords to describe document contents. The ‘key-image’ concept establishes a legitimate approach to indexing documents with multiple perspectives in technical, professional and social areas. In this sense, document retrieval systems tend to adopt universal cognitive paths in knowledge organization systems (KOS) based on imaged communication, since they are no longer limited by the written language. This contribution to knowledge representation is supported by semiotic theories and presents an opportunity for documentation to evolve into the information technology (IT) society. The imaged indexing methodology can be implemented in user-focused systems compatible with the IFLA-LRM\(^1\) model for social and cultural interoperability (Mustafa, 2015) throughout OPACs\(^2\).

\(^1\) IFLA – International Federation of Library Associations and Institutions; LRM - Library Reference Model (Salaba et al., 2011; Riva et al., 2015; Riva et al., 2017).
\(^2\) Online Public Access Catalog.
Web search engines may use these alternatives for indexing techniques to support KOS performance. A broader area for interface development is now available with effective benefits for people with functional illiteracy such as deafness. In short, using images to create bonds between users and documents meet KOS challenges on a prosperous scientific basis.

Today the human-machine interfaces of document management systems (DMS) explore innovative solutions that may renew the concept of library, known as a cultural and social space which is close or distant, material or virtual. The envisaged solutions prioritise the organisations' mission rather than the technology employed. New libraries aim to be closer to their users by means of a set of characteristics identifying documental organisations attempting to “associate immaterial with material (for example the OPAC), local with distant (open/close/semi-open client-server architecture) and visible with invisible (semantic data on the bibliographical notes)” (Papy 2016, 13).

The concept of indexing with images outlined by Caribé and De Brito (2015) presupposes the use of intentionally composed images for document indexing purposes. Both indexing methods are complementary, and besides the role it plays in indexing languages, the ‘key-image’ based interface is becoming an imaged navigation tool which is far more intuitive than former written methods.

This study presents the results of an experimental validation step, as a milestone in the ongoing research project, demonstrating document/key-image correspondence while referring to information contents.

2. Presenting the study

Starting from the conceptual model of indexing with images (Caribé and De Brito 2015) the working hypothesis has been formulated to suggest that there is an “image-document” relationship from which the objects of the image refer to the objects of the discourse within a document, or a set of documents, in a relationship generally independent from the variable of orality, meaning independent from literacy. Considering that "visual literacy", which derives from gestures and images, is complementary to "oral-written literacy", they can be combined to minimise functional handicaps in communication.

2.1. The context

To verify the working hypothesis, an experimental context has been created in which the participants are, as far as possible, exempt from using their oral skills, meaning that they lack the speech or reading-writing mechanisms common to traditional DMS.

As developed by Marschark et al. (2000; 2004) knowledge organisation in deafness is a matter of mind. The oral communication variable is here interpreted as the physiological competences that lead to the development of oral and written languages. “Orality”, as designed by educational experts, is intrinsically linked to hearing because it is by depicting sounds that humans develop speech and consequently acquire the reading and writing competences proper to natural language. Sign language (SL), however, responds to those same properties without borrowing the same oral communication channel. SL is the visuospatial alternative for communication between
deaf people under a grammatical formal basis. SL users develop literacy which is appropriate for their linguistic universe and, therefore, sufficient for minimal integration in current social life. For these individuals, oral communication is deficient or total absent, and, moreover, incompatible with common social reading spaces.

We have thus defined an experimental protocol centred on the cognitive functions related to images and, at best, free from the interference of orality variables (reading-writing).

The existence of this cognitive image-document association is at the centre of our interest. To a certain degree these cognitive skills demonstrate the existence of intuition in the process. However, no particular concern has been emphasised about the nature of the process or the interpretative mechanisms used by individuals to achieve tasks.

Questions about reading access become clearer when viewed from the point of view of deaf education. Several scientific studies have dealt with this subject. Studies by Daniel Daigle (University of Montreal), Anne-Marie Parisot, and Colette Dubuisson’s (UQAM) have led to a new understanding of how socializing with others is a motivating factor for attending school, as well as for making friends or developing psycho-social skills equivalent to those of hearing people (Dubuisson et al. 2009). Key to this social success, the most important factors are related to the development of language. Indeed, a language deficit is not always linked to deafness, but is due to some environmental variables that would cause a lack of accessibility to language. Luna et al. (2016) report on the dynamics of social power that plays an important role in interpersonal relationships and a certain sense of contempt for the hard of hearing, that destroys the fabric of trust, necessary for developing language skills, bilingualism and balance between diversity.

Among the influential oral communication factors, Dubuisson, quoted by Luna et al. (2016), highlights external factors such as: (i) the subject being treated; (ii) the competence of the interlocutor, (iii) the situation of the signer (e.g. hands occupied), and (iv) the communication intention. In addition, linguistic contacts with the family or the social milieu play a crucial role in the evolution of SL skills.

In her thesis about the bilingual and multimodal approach to orality in the deaf child, Isabelle Estève (2011) discusses other aspects that influence oral communication. According to her, a holistic and pictorial form of communication could fill expressive gaps, because the pictorial and linguistic organisation of thought forms part of an "integrated bimodal language system". These modalities represent the organisation of information that comes from a language that is preferentially gestural. In the childlike multimodality of the deaf, Estève recovers the links between vocal communication and gesture, evoking a vertical, dynamic and global component of statements that combine the linguistic and pictorial skills related to contents.

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3 Université du Québec à Montréal (UQAM).
Therefore, from Estève's assertions (2011) it is inferable that there is an image iconicity for the lexicon as much in the sense of Saussure, a word sign, as in the sense of Peirce, a sign-image.

In addition, Perini and Righini-Leroy (2008) stress the importance of giving deaf learners access to writing practices. She draws our attention to the effectiveness of visual tools and multimedia support, for their capacity to present simultaneously text, images and statements, providing additional motivation for the learner. Illiteracy is basically the most common side effect of deafness, partly due to educational and school experiences that would produce an inappropriate blocking effect associated with some linguistic insecurity against the vernacular second language. To remedy this, the learner must gradually be brought to master reading and writing in a perspective of successful citizenship.

From a quantitative point of view, according to WHO\(^4\), more than 5% of the world's population, or 360 million people, suffer from disabling hearing impairment, \(i.e.\) 328 million adults and 32 million children. Daigle, quoted by Tominska Conte (2013), reports that in the United States although there are 30,000 deaf students in higher schools, only a quarter of these students complete their studies. In Europe few deaf people reach High School level.

Through these studies it is formally recognised that the barriers of functional illiteracy are a handicap embedded within another handicap.

2.2. The experimental plan

The study population was divided into groups. The first group consisted of twenty-six individuals, all deaf, SL students, who volunteered to test our hypothesis. The control group consisted of thirty-one students in librarianship\(^5\).

The documental corpus included a batch of 50 scientific articles taken from the SciELO\(^6\) electronic library. The objective of this specialised corpus is to know whether the method of indexing with images applies to scientific documentation, since it is more formal, loaded in text and less illustrated. The documents in the SciELO library were obtained by simple queries on specific chosen domains, namely: Sports [football; handball; swimming; tennis; others] and Animals [crocodile, monkey, toucan; others]. The subclass "others" represents the elements of doubt, ambiguity or even out of context, often encountered in documental research in real situations.

Pre-processing the abstracts: We chose to summarise the texts making them easier for the interpretant in SL. Also, by simplifying abstracts, we intended to enhance text comprehension for a non-scientific public.

Composing the ‘key-images’: We applied the collage technique to a selection of

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\(^4\) World Health Organisation. URL: http://www.who.int/mediacentre/factsheets/fs300/fr/

\(^5\) Faculty of Information Sciences, University of Brasilia-Brazil

images, from public domain (Google images) according to the pre-established procedure proposed by Caribé and De Brito (2015) and following Pierce’s (Nöth 2012) and Bertin’s (1970; Dantier 2008) semiotic principles.

Experimental proceedings: The abstracts were interpreted in SL and recorded separately in video format. They were randomly selected for the test. Each video corresponded to a document, both identified by their numbers. The ‘key-images’ were presented in PowerPoint format, organised according to classes (Sports and Animals). At the end, the participant’s choice was recorded on the answer form. The number of documents presented in the session was limited by the time available, which averaged around 100 minutes/session and 10 minutes/document, 16 documents in total for the deaf students. For the librarianship students, there was one session test with 19 documents in total, taking around 120 minutes/session and 6 minutes/document on average.

The answer form structure consisted of two parts: I) The individual’s profile: a) age; b) gender; c) level of education; d) degree of deafness; and e) competence in SL. II) The document-image association: a) choices in ordering class menus. Indirectly measuring the ability to follow hierarchical paths; b) Degree of personal difficulty with regard to the subjects and; c) Choice of 'key-images' best corresponding to the document presented (in LS).

2.3. Findings

The first group of 26 sign language (SL) students is heterogeneous in age, [18-25] 42%, [26-35] 23% and [36-45] 23%. They have a preponderance to being profoundly deaf (23% severe and 54% profound) and despite this significant handicap, the majority (69%) of students reported having high school level, and 27% having a university degree. Concerning sign language skills, the group is homogeneous at 92%, with strong SL experience.

The second group of 31 librarianship students is in the main represented by young people aged 18-25 years old (84%), studying at university (90%) or having a previous university degree (10%).

On a scale from 1 (very easy) to 5 (very difficult) (Erro! A origem da referência não foi encontrada.), the individuals’ perception about the subjects (scientific articles) was easy and moderately easy to understand (in SL) for 65% of them (level [1] 45% + level [2] 20%). On the other hand, for 75% of the library students the exercise was easy and moderately easy to understand (level [1] 54% + level [2] 21%). Corresponding to the rates of difficulty, exact matching of image and associated document was accomplished by 53% of SL students, followed by 88% of the library students.

In fact, the results of the exercise demonstrated that there is a correlation between these two entities, document and 'key-images'. The success rates of 53% of the SL students and 88% of the library students have confirmed our assumption about indexing
with images. The complexity of the document's subject and the cognitive mechanisms of retrieval seem to influence each other. This can explain how 39% of failure is related to the 27% (13% + 8% + 6%) of the overall difficulty for the SL students. Likewise, for the librarianship students, the 12% of failure is related to the 25% of perceived difficulty. The gap between these two variables may also have occurred due to external factors such as: a) inaccuracy of the indexing technique, b) image quality and/or choices relating to Google's image collection or c) misunderstandings due to the complexity of the subject. Regarding the effectiveness of the method, the average time spent on understanding the contents and finding and reaching a key image for each document was about 10 minutes for SL students and 6 minutes for librarianship students. Mastering the mechanisms of the retrieval system emphasises both the comprehension path leading to document content as well as the consistency of the document/key-image association process, thus testifying to the intuitiveness of the "indexing with image" tool.

Figure 1: Proportion of levels in perceived difficulty regarding document content, comparing SL and Library students

The proportionality graphs (Erro! A origem da referência não foi encontrada.) show the results by document for each group related to the document/key-image association achievements.

The unanswered questions indicate the presence of residual barriers, not solved during the sessions, probably due to the indexing method, to the subject's complexity, or else related to SL skills. This behaviour raises another question, namely the effectiveness of the message conveyed by the ‘key-images’ according to the linguistic competence of the interlocutors (Luna and Parisot 2016). It should be considered that this phenomenon, also found in systems with keywords, cannot be controlled downstream of the process without compromising the validity of experimental protocol. Overall, the results are significant, especially coupled with the enthusiastic appreciation from the students, recorded on video testimonies at the end of each session. This motivational variable meets the viewpoint of Dubuisson et al. (2009) concerning the
appraisal of psycho-social skills motivating individuals towards reading practices.

Figure 2: Proportion of success in corresponding document with ‘key-image’, comparing SL and Library students

As documents were selected randomly, only a few of them happened to be analysed by both groups of students. In those cases, as can be seen in the graph (Figure 3), despite the SL students’ oral communication barriers, the results exceeded expectations, being very close to the contrasting group of librarianship students.

Figure 3: Comparison of text-image association with documents beyond groups

3. Concluding remarks

Our hypothesis revisits the issues of document and indexing concepts in a multidisciplinary and innovative approach. With a methodological basis in semiology and discourse linguistics, it proposes adopting the indexing by image conceptual model
previously developed. It is now understandable that designing a KOS aiming to improve reading practices is a multidimensional research problem involving: document processing, data model, system interface and social and cultural interoperability. The experimental plan takes into consideration the theoretical contributions of the education domain regarding the study of reading by multimodal didactics concerning image (visual and oral communication).

By conducting the experiment with both hearing impaired and non-impaired student groups it was possible to evaluate variables such as the relevance of indexing with images, the importance of the visual in the document retrieval process and the difficulties facing orally challenged users in the information acquisition process.

The methodology emphasises the communication barriers caused by the absence of reading-writing skills. Moreover, since the SL group was not familiar with most of the scientific fields covered by the documents and as there was innovation in the method of knowledge organization, the experiment has brought up a new uncommon difficulty. Nevertheless, the results clearly demonstrated that the group was able to establish at first glance a univocal association between a scientific article and its corresponding ‘key-image’. This set of characteristics denoting efficiency and intuitiveness was pointed out by most of the students in favour of the envisaged information system.

Concerning interoperability, making a scientific document accessible to a heterogeneous, non-reader public requires breaking through an important functional barrier. It presents a new perspective on communication with library users in general, particularly aiding functional illiteracy. With this in mind, the next stage of study will be to apply this same experiment to a culturally and linguistically distinct public so as to endorse the interoperability paths explored herein.

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References


