Subject-field classification of theses and dissertations in digital libraries

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Abstract

Digital libraries represent a worldwide effort in storing, preserving, providing access and disseminating scientific production. Considering the growth of electronic files to be organized, we propose to investigate the principles of adequate thematic structures for thesis and dissertation digital libraries. The aim is to provide assistance for making such structures in the field of Information Science, and also to identify aspects of theory and methodology applicable to the organization of thesis and dissertation digital libraries at higher learning institutions. In terms of the organization of knowledge, two theoretical trends were systematized: macro- and micro-structural. For the macrostructural theory, theoretical and methodological aspects are more appropriate for reaching goals by compiling theories which start at the disciplinary level, moving up to more general themes to explain concept structures. The microstructural theory, which holds that the theoretical corpus is the minimum knowledge unit, studies the relationship between concepts. The trends observed within the macrostructural theory are the conceptual map, thematic domain, semantic fields and terminological theories. The evaluation of these theories revealed the importance of the social and cultural context for conceptual relationships of knowledge organization to be used in digital environments through interaction, be they for individual use or for the numerous actors involved in digital libraries.

Keywords

thesis classification, scientific production dissemination, digital libraries, Universidade Estadual Paulista, knowledge organization, conceptual mapping

1 Introduction

The present study endeavors to organize the information related to theses and dissertations in digital libraries through a structuring by subject-field categories adapted to the specificity of scientific contents; for this purpose, we investigated the theoretical and methodological principles for a thematic structure that would be suited to the environment of digital libraries for theses and dissertations; our goal was to provide help

tools to classify the different themes within the context of Information Science, and identify the aspects of theory and methodology to be applied when organizing digital libraries of theses and dissertations at institutions of higher learning.

The scientific production of theses and dissertations is crucial for the progress of science, and the faster and the more diverse the progress, the greater the necessity of specific and up-to-date information. The organization of content in digital libraries of theses and dissertations is necessary due to the increasing amount of documents and specificity of subjects. Thus, easy storing in digital libraries is all the more evident, as one now can digitalize, store and retrieve resources thanks to software that ensures the access and preservation of digital files, thereby giving them a new format and enabling a new way of reading.

As a result of such facilities, the worldwide trend is working towards storing, preserving, providing access to and disseminating scientific production through electronic environments called «digital libraries». This movement started with scientific journals of varied fields. Universities, major generators of knowledge in the form of theses and dissertations, started to digitalize and store them in digital libraries.

In Brazil, the digital libraries of theses and dissertations of the state universities of Sao Paulo State, Sao Paulo University[3] (USP), Sao Paulo State University[4] (UNESP), and Campinas University[5] (UNICAMP) have structured categories of subject fields into tables that subdivide the fields of knowledge of research-promotion agencies and name the fields of specialization of postgraduate studies.

Although the resource is used by the institutions to divide fields of research, the theses and dissertations are classified into categories that are too generic and that do not enable the required adaptation for the specific knowledge generated through theses and dissertations. If we take the subject of «Photons», for instance, which is related to the field of Physics; we observed shortcomings in the way the digital libraries of the three universities are structured as to specific conceptual subject-field categories; as a result, access to this information and its retrieval may be more difficult. For instance, if we take the dissertation entitled «Radiation dose calculation through convolutions in heterogeneous media for radiotherapy applications», whose subject is «Photons», we observed that it has been filed under the category «Physics» –which is a single structure and does not have field subdivisions or more specific subjects– among all the other theses and dissertations and regardless of subject specificity.

An empirical study of the way the information of theses and dissertations is organized in digital libraries reveals three aspects, which eventually render subject classification difficult: 1) the way in which research institutes determine how subject fields are to be represented in field-of-

3. http://www.saber.usp.br
4. http://www.biblioteca.unesp.br
5. http://libdigi.unicamp.br

specialization tables of postgraduate studies; 2) how the subdivision of fields is generalized as to the specificity of the knowledge generated by the theses and dissertations; and finally, 3) the way in which the categories of subject fields are structured, since it has a direct impact on the way theses and dissertations are retrieved.

The difficulty in classifying the knowledge generated by theses and dissertations in the current structure of categories of digital libraries limits IT professionals and users to a structure of subject categories that is very broad and not very specific. What principles must we, therefore, use when creating a structure of subject fields that is more suited to the environment of digital libraries of theses and dissertations, considering the growing electronic documentation to be organized and stored?

We assume that the elaboration of a structure by subject categories in digital libraries of theses and dissertations will enable an easier classification and inclusion of those documents, and thereby allow users to access the contents and retrieve the information required. Thus, a theoretical and methodological study was conducted to organize the information so as to have tools for the elaboration of a structure of subject-field categories and subcategories and for the organization of a global macrostructure that encompasses all fields of knowledge of a thesis digital library.

To identify the tools required for a proper structure of categories by subject fields for digital libraries of theses and dissertations, we evaluated the fundamental and interdisciplinary concepts of Information Science. Our central investigation for the organization of information by themes was based on theoretical and methodological references and on the theoretical dimension of the organization of the knowledge that identified macrostructural theories: conceptual map; thematic domain; semantic fields and terminology. For the macrostructural theory, the evaluation we conducted revealed that theoretical and methodological aspects are more suitable for reaching our goals, as they enable the consolidation of theories –from the very disciplines down to more general themes– that explain how concepts are structured.

2 THE ORGANIZATION OF KNOWLEDGE IN INFORMATION SCIENCE: THEORETICAL AND METHODOLOGICAL ASPECTS FOR THE ELABORATION OF SUBJECT CATEGORIES

Information Science, a field considered to deal, among other aspects, with the representation and organization of knowledge, is recognized by Saracevic (SARACEVIC 1996) as the field connected to scientific questions and to the professional work related to the communication of knowledge within the social, institutional, or individual context of information use and needs. It works on the information so as to design some content, present a form and mainly establish a meaningful link

with the user, since only the recognizing of the interests in information and information needs will establish a link between users and information systems, and will then allow for an effective communication function. Therefore, it is important to develop studies within Information Science on the organization of information for an effective enhancement of information flows in information environments for the users involved.

Barreto and Smit (BARRETO 2002, p. 21) consider that it is important to highlight that «[…] not all the information is to be stored, not all the information is to be registered […], as soon as some information is stored, it starts existing within the institution, and therefore society», since any treatment of the information flow must be contextualized for the information to establish meaningful links with its users.

Thus, it is important to have registered information on the knowledge produced by man in any type of document which can be potentially used by other men. This interaction of registered knowledge with users in an information system highlights the contact with previous knowledge, concepts and languages acquired by users, in order to establish a socialization process that eventually creates meaningful links among them and making communication efficient.

Within this context, we consider that the organization of registered knowledge generates new knowledge, which, on becoming part of society, becomes new information, thereby generating new knowledge. This cycle involving the organization of knowledge as «discipline» intends to study ways in which knowledge may be grasped, organized, and represented to establish an increasingly greater number of meaningful links among the users involved.

For our theoretical approach on the organization of knowledge within Information Science, as a field of study, it is noteworthy to refer to the definition of García Marco (GARCÍA MARCO 1995) who considers the organization of knowledge as [a]

> […] field dedicated to the study and development of foundations and techniques for the planning, elaboration, management, use, and evaluation of a system that specifies, catalogues, orders, classifies, testifies, preserves, and transmits knowledge and acts from the contents it extracts to ensure its conversion into information capable of generating new knowledge.

Likewise, Hjørland (HJØRLAND 2003) acknowledges that, for the Information Science community, the Organization of Knowledge means the organization of bibliographic records, including quotation indexes and complete text records, among others. The basic purpose of Information Science is to establish the best approach for the Organization of Knowledge, while optimizing the means for the use and acquisition of records when retrieving information.

The author (HJØRLAND 2003) also highlights that the concept of knowledge organization is very broad, since it is related to the social di-

vision of work (disciplines); social institutions (universities), languages and symbolic systems, conceptual and theoretical systems, and also with literatures and genres. The author believes, indeed, that Information Science has very often ignored the comprehensive meaning of theories on the organization of knowledge, which are essential to build efficient information-organization systems.

All the efforts made towards knowledge organization are justified, according to Barité (BARITÉ 2001, p. 39),

> […] because humanity only advances when the knowledge accumulated is systematized to fulfill certain goals and because the exchange, communication, debate, distribution, and dissemination of specialized knowledge is only made possible when reaching a consensus on this knowledge.

The different practices and social activities entailed in the access to knowledge intend to operate as tools to treat the information and manage its use, while integrating the phenomena and applications of access structures and arrangements in the dissemination of socialized knowledge.

Thus, one may consider that the organization of knowledge entails fundamental and theoretical studies based on approaches such as the theory of systems, the theory of communication, the development of sciences and principles of representation and organization of concepts, which when applied to the studies of information organization, contribute to the development of the activities and operations for the treatment of information.

With the purpose of summarizing the theoretical corpus of the Organization of Knowledge and the field of Information Science, Barité (BARITÉ 2001) proposes the two theories that he considers as trends for those fields. The first one is the theory that starts from the disciplines and moves on to more general themes to explain the structure of systems of concepts, defined as macrostructural theory. The second theory, called microstructural theory, considers the theoretical corpus as the minimum knowledge unit; for this purpose it studies the concept and its different presentations within Information Science and Terminology. As its theoretical and methodological aspects are regarded as being more appropriate to reach the goals we set, we focused on the use of Macrostructural Theories, which include the Conceptual Map Theory, the Thematic Domain Theory, the Semantic Field Theory, and the Terminological Theory.

After identifying the macrostructural theory in literature, we conducted a theoretical-reference survey for each theory in order to have the tools to structure subject-field categories and subcategories and to organize the global macro-structure that encompasses all fields of knowledge of a digital library of theses and dissertations.

Conceptual Map

Conceptual maps may be considered as learning tools to help users understand and relate contents such those discussed in class with students.

The conceptual map theory offers theoretical tools to make the list of concepts of greater relevance for the elaboration of concept groups, from the more general to the less general by means of cognitive strategy.

Domain Analysis

The theory of domain analysis offers tools to build subject-field categories by understanding information through knowledge domains or in speech communities that are inserted in the social division of work, where we have an organization of knowledge, structures, cooperation patterns, language and forms of communication, information systems, and relevance criteria. The theory considers the organization of a scientific community, the evolution of the institutional corporeity, and its internal points of division of work, which are crucial factors when producing knowledge.

Human knowledge disciplines are also considered when treating an information system for the approach of a specific domain, because this information cannot be recognized in an unqualified reality, but only in the scientific circles of education, for sciences are historical products requiring a qualified reality. Another point to be emphasised in this theory is the presentation of a generalized knowledge on paradigms, methodologies, and trends in the production of knowledge in its historic, social, organizational, and political context.

Semantic Fields

The theory of semantic fields offers tools to identify and transform the semantic traits of words from natural language to build category structures, and determine the users involved so as to establish associations pertinent to a determined field of knowledge. Words within semantic fields refer to a particular domain of knowledge or field of activity, which establishes their meaning and make them a source of meaning through a specific interpretation that reduces ambiguity.

To establish semantic fields, a diligent updated identification process is necessary, whereby the vocabulary base of the field of knowledge is identified by categories of words of this vocabulary base so as to form a semantic field of the field in question.

Terminology

Terminology offers tools for the representation of the specialty language and terms inserted in a given field of knowledge, which must be adapt-

ed to the vocabulary used in the field. This theory considers the terminological information that comes from the theoretical and methodological aspects entailed in the study of concepts, and works on its representation by means of the specialty language.

The establishment of a concept is fundamental for the organization of knowledge because it recognizes the objects and grouping in meaningful units of a particular domain, stresses the importance of identifying the target public and establishes a representative corpus of the subfield.

The context in which those theories are to be applied corresponds to the environment of the digital libraries considered by Lesk (LESK 1997) apud Borgman (BORGMAN 1999, p. 235), namely, «[…] a collection of information that is digitalized and organized […]», highlighted here with a special focus on digital libraries of theses and dissertations, according to the importance of the organization and treatment that this informational content has, because knowledge is a social product, in which matters of identity of a society are involved, and are essential for the constant development of knowledge.

According to Ziman (ZIMAN 1968, p. 116), «[…] the literature of a field of research is as important to the field as the very research papers this field publishes […]», therefore, without any scientific production, the dissemination of scientific knowledge becomes limited, which jeopardizes the progress of science. The dissemination of scientific production affords greater visibility to the studies and research works conducted and thereby speeds the intellectual development and generation of knowledge. Theses and dissertations in this context are considered one of the more relevant tools within scientific communication.

Thus, the organization of the knowledge generated in theses and dissertations is of utmost importance, as it must be classified in subject fields in a digital library environment for proper organization, storage, preservation, access, and dissemination of the scientific production of a determined community.

In the days of Aristotle, naming, defining, and categorizing were already a matter of concern. Many authors consider the terms categorization and classification as synonyms (GARDNER 1996; JACOB 1991; SMITH 1981). With the developments in Cognitive Science, the understanding of categorization has suffered some changes over the last three decades. Categorization moved from an individual cognitive process to a cultural and social process of building a reality, which organizes concepts partially based on the psychology of thought. Perceptive information is crucial to the definition of category extensions because categorization is not made artificially, but rather by considering the information of the world, in which we belong and how we respond to this information. Categorization entails the recognition of similarities and differences, which lead to the creation of new knowledge, by grouping entities according to those similarities and differences (LIMA 2003, p. 82).

The author also says that to organize the knowledge of any field, from representation to retrieval, the concepts behind this field of knowledge, as well as the relations between those concepts, must be studied first. The influence of context is so important in categorization that any particular disqualifying description in its classification may be extremely limited. This is why we started our investigation from the existing structure, based on tables of field-of-knowledge subdivisions, while considering the specialists' experience to compose their specific context.

The categorization process is of utmost interest for Information Science and Cognitive Science as regards the strategy of classifying objects of cognition such as things, facts, and phenomena (LIMA 2003, p. 83).

Since the use of categories is essential to the process of differentiation and classification of the social world, we may consider Information Science as an integral part of social matters, according to Buckland (BUCKLAND 1999, p. 14). Information Science, a field dealing with the representation and organization of knowledge, takes into account scientific matters and the professional practice related to the communication of knowledge within the social, institutional, or individual context.

Fujita (FUJITA 1992) points out the influence of context on elaborating what she defines as «classification models». As the natural organization of the analyzed system and the organized knowledge of the specialist are considered to be parameters for the identification of classification of models, the structure is established through a consensual field organization. For that purpose, in an experiment, the author adopted three parameters to elaborate a structure of categories for a Dentistry thesaurus: the previous knowledge of the specialist, the curricular structure of the Dentistry course, and the departmental structure of a College of Dentistry.

The investigation of the theoretical and methodological principles of macrostructural theories when creating macrostructural subject categories is essential for the information representation, as digital libraries of theses and dissertations will provide their users with an array of types of access to their informational content through their search interface. Users will have a distinct selecting system and within the context of their particular research so as to equate their matters with the essence of the informational structure for an easy access and retrieval.

3 INFORMATION ORGANIZATION IN DIGITAL LIBRARIES OF THESES AND DISSERTATIONS: PROPOSED APPLICATION OF MACROSTRUCTURAL THEORIES

Sao Paulo State Universities provide digital access to theses and dissertations through digital libraries that enable the digital retrieval of the complete text of those documents, as well as customized services for registered users. Upon analysis of the thematic structure of the digital li-

braries of theses in three state universities of Sao Paulo State, namely USP, UNESP, and UNICAMP, the parameters identified to elaborate their category structures are the major fields of knowledge determined by Brazilian research institutes, and the fields of specialization and research lines of postgraduate studies of each institution; for example, the current subdivision of Physics is the very field of Physics, and is therefore too broad as a category to include every thesis and dissertation of a field of knowledge.

Considering that both inclusion and access to theses and dissertations in the digital libraries of those three institutions is selected by the users to find the required information, a poor description of the resources that support a given field of knowledge may be problematic for the inclusion, access, and retrieval of information by users. The analysis of the macrostructural theory proposed here will provide theoretical and methodological tools, i.e. guiding elements for a general understanding of a specific domain or field of knowledge, since the current structure is based on parameters that only consider the subdivision of major fields and subfields that are far too generic and static to absorb the specificity of subjects found in theses and dissertations. The importance of analyzing macrostructural theories lies in the possibility of working on more general thematic terms to explain how concepts are structured in order to establish a global macrostructure.

Thanks to the evaluation conducted in the four macrostructural theories, we rejected the use of the Theory of Conceptual Maps, since it is an educational tool intended for students in the learning process; besides, they require the building of other maps with various levels of generalities to represent various ideas focused on an educational use. Therefore, the prominence of domain analysis, semantic field, and terminological theories is evident, as they reveal the importance of the social and cultural context when establishing the relationships between the concepts of the information organization to be applied within an environment based on the interactions of all the people involved just like that of Digital Libraries of theses and dissertations.

For that purpose, the tools viewed as the most important in each theory are exemplified, and an application in a category organization is proposed in the field of Physics.

Proposed application of aspects of domain analysis

The domain analysis theory as a support for the organization of information in digital libraries of theses and dissertations of the field of Physics should take into consideration:

— the specialty language adopted by the field specialists;
— reflect the studies developed in academic communities and their role in society;
— the patterns of communication and information;
— the practices of the members of research group;

— the current lines of research of postgraduate studies of each institution;
— the tables of fields of knowledge determined by the research institutes;
— the manuals and dictionaries considered within the field;
— identify the trends of theories;
— the subjects under study.

Propose application of terminology aspects

We consulted 3 researchers of the Institute of Theoretical Physics at the UNESP to explain the organization of knowledge on Photons in the field of Physics, and identified the following research subfields on Photons: Particle Physics, Field Theory, Quantum Optics, Plasma Physics, Medical Physics, Nuclear Physics, and Gravitation. In order to define those fields, the researchers informed the dictionaries specific to each field of research.

A definition of the fields and terms used in the specialty language of the fields of Physics related to the subject of photons according to the manuals and dictionaries of the field is provided hereunder.

Physics –science that deals with the structure of matter and its interactions between the fundamental constituents of the universe.

Elementary particle physics –branch of science that studies the fundamental constituents of all matter in the universe.

Quantum field theory–theory of the quantum mechanics applied to systems possessing an infinite number of degrees of freedom. Particles are represented in fields that have quantized degrees of oscillation.

Optics –the branch of science that studies the light and phenomena associated with their generalization, transmission, and detection. Includes all the phenomena associated with infrared and ultraviolet radiations.

Nuclear physics –study of the components, structure, and behaviour of the nucleus of the atom. It is especially concerned with the nature of matter and with nuclear energy.

Plasma–fully ionized gas of low density, containing approximately equal numbers of positive and negative ions. It is electrically conductive and is affected by magnetic fields.

Gravitation –study of the attractive force existing between two particles of matter.

Relativity –physical theory introduced by Albert Einstein that discards the concept of absolute motion and instead treats only relative motion between two systems or frames of reference. The modern theory is an extension of the simpler Galilean or Newtonian concept of relativity, which holds that the laws of mechanics are the same in one system as in another system in uniform motion relative to it.

Source: Isaacs, Alan. *Dicionário breve de física*. Lisbon: Editorial Presença, 1996
    A concise dictionary of physics. New York: Oxford University Press, 1990

Considering the theoretical tools of Terminology in the representation of specialty language, the subfields of the field of physics were defined in the context of the subject «photons» so as to organize the concepts involved for the formation of a Semantic Field.

Proposed application of semantic field aspects

The field of Physics deals with the structure of matter and its interactions between the fundamental constituents of the universe. In this context, the subject of photons, in other words, the light composed by particles of electromagnetic radiation is the subject under study of various Physics subfields. As verified in the dissertation entitled «Deflection of photons by the sun in the context of the theory of gravitation "R+R POT.2"» to be found in the Digital Library of UNESP and which studies the effect of gravitational fields on photons, the subject of photons is under the subfield Theory of Gravitation.

Physics
Particle Physics
Field Theory
Quantum Optics
Plasma
Medical Physics
Nuclear Physics
Gravitation

The use of the Semantic Field Theory together with that of domain Analysis and Terminology contributed to forming the group of subfields of Physics related to the subject of Photons, as they are structured under field categories through the definition of concepts establishing a relation between them.

3.1 Analysis of the applicability of macrostructural theories for the classification of subject fields

The theoretical and methodological tools taken from the domain analysis, semantic fields, and terminological theory broaden the possibility of an expansion of the current structure of subject-field categories on the digital-library websites of Sao Paulo State universities when considering essential elements for the development and treatment of a given field of knowledge.

Based on the analysis of the current structure of the categories of sub-ject fields presented in the digital libraries of theses and dissertations of Sao Paulo State Universities, we noted a lack of theoretical guiding ele-ments for the organization of information, as those subject-field cate-gories present neither an indexing policy nor even follow a documenta-tion language for the existing structure to be more suited to their own particular context.

Based on the theoretical approach and the results of the proposed ap-plication of the aspects found in the three theories, we may indicate a se-quence to determine a global macrostructure that:

a) makes it possible to establish the information relevant to the *domain* studied;
b) identifies fields and subfields that are defined according to the tools used in the *terminological theory*;
c) is used when forming the *semantic field* according to the position of fields and subfields within a field of knowledge.

Thus, we may assume that the application of macrostructural theo-ries, i.e., the Domain Analysis Theory, the Semantic Field Theory, and the Terminological Theory may supply the tools for the elaboration of a structure of subject-field categories, that is, the formulation of a global macrostructural organization adapted to the environment of digital li-braries of theses and dissertations.

4 FINAL CONSIDERATIONS

The lack of a global subject-field macrostructure limits theses and disser-tations within subject categories that are too generic, as seen in the struc-ture of the digital libraries of Sao Paulo State universities; considering the approach assumed in the tables subdividing the fields of knowledge of research institutes and names of specialization fields of postgraduate studies, which do not follow the developed specificity of the knowledge generated through theses and dissertations.

The study investigated the principles for a thematic structure adapt-ed to the environment of digital libraries of theses and dissertations through the identification in the literature of the macro- and mi-crostructural theories, which summarize the theoretical corpus of knowledge organization within the context of Information Science. Those theories, and more particularly the macrostructural theory used for the purpose of providing tools to elaborate a structure of subject-field categories, render it possible to gather theories from disciplines drilling down to more general terms so as to explain how concepts are structured.

The analysis conducted through the macrostructural theories defined the use of domain analysis, semantic field and terminological theories as adequate for the development of our proposal, since they broaden the

possibility of an expansion of the structure of subject-field categories in the websites of Sao Paulo State universities by considering essential elements, as well as the social and cultural contexts when building the conceptual relationships of knowledge organization to develop and treat a given field of knowledge. We also observed possible complementarities when applying the theoretical aspects of the three theories, which allowed us to identify the sequence for the global macrostructure of subject-field categories.

For future studies, we highly recommend the application of those tools in any methodological proposal of subject-field classifications, as well as the analysis of the digital library users' view of such a structure.

REFERENCES

(BARITÉ 2001) BARITÉ, M. «Organización del conocimiento: un nuevo marco teórico-conceptual en bibliotecología y documentación». In: *Educação, universidade e pesquisa*. (Marília: Unesp-Marília-Publicações; Sao Paulo: FAPESP, 2001), p. 39.

(BARRETO 2002) BARRETO, A.; SMIT, J. «Ciência da Informação: base conceitual para a formação do profissional». In: *Formação do profissional da informação*. (Sao Paulo: Polis, 2002), p. 9-24.

(BORGMAN 1999) BORGMAN, C. «What are digital libraries? Competing visions». *Information Processing and Management,* n. 35 (1999), p. 227-243.

(BUCKLAND 1999) BUCKLAND, M. «Vocabulary as a central concept in library and information science». In: INTERNATIONAL CONFERENCE ON CONCEPTIONS OF LIBRARY AND INFORMATION SCIENCE (3rd: 1999: Dubrovnik, Croatia). *Digital Libraries: interdisciplinary concepts, challenges, and opportunities: proceedings of the Third International Conference on Conceptions of Library and Information Science. (Zagreb: Lokve)*, p. 3-12. Available online: <http://www.sims.berkeley.edu/~buckland/colisvoc.htm> [cited 20 November 2002].

(FUJITA 1992) FUJITA, M. S. L. *Linguagem documentária em odontologia*: *uma aplicação dos sistemas de indexação PRECIS*. Sao Paulo: ECA/USP, 1992. Tese (Doutorado), Programa de Pós Graduação em Ciências da Comunicação, Escola de Comunicação e Artes, Universidade de Sao Paulo, Sao Paulo, 1992.

(GARCÍA MARCO 1995) GARCÍA MARCO, F. J. «Los contenidos y la secuencia docente de la Organización y Representación del Conocimiento: una propuesta interdisciplinary». In: ENCUENTRO DE ISKO-ESPAÑA (1er: 1993: Madrid). *Organización del conocimiento en sistemas de información y documentación*. (Zaragoza: Universidad de Zaragoza, 1995), p. 219-228.

(GARDNER 1996) GARDNER, H. *A nova ciência da mente: uma história da revolução cognitiva*. Sao Paulo: EDUSP, 1996.

(HJØRLAND 2003) HJØRLAND, B. «Fundamentals of knowledge organization». *Knowledge Organization*, v. 30, n. 2 (2003), p. 87-111.

(JACOB 1998) JACOB, E. K.; SHAW, D. «Sociocognitive perspectives on representation». *Annual Review of Information science and Technology*, v. 33 (1998), p. 131-185.

(LESK 1977) LESK, M. E. *Practical digital libraries: books, bytes, and brucks*. San Francisco: Morgan Kufman, 1997.

(LIMA 2003) LIMA, G. A. B. «Interfaces entre a ciência da informação e a ciência cognitive». *Ciência da Informação*, v. 32, n. 1 (Jan. / April 2003), p. 77-87.

(SARACEVIC 1996) SARACEVIC, T. «Ciência da informação: origem, evolução e relações». *Perspectivas em Ciência da Informação*, v. 1, n. 1 (Jan. / June 1996), p. 41-62.

(SMITH 1981) SMITH, E. E.; MEDIN, D. L. *Categories and concepts*. Cambridge, Mass.: Harvard University, 1981.

(ZIMAN 1968) ZIMAN, J. M. *Public knowledge, the social dimension of science*. London: Cambridge University Press, 1968.