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Article

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Knowledge Universe: classification and categorization from the perspective of knowledge organization

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ABSTRACT

Introduction: Knowledge organization (CO) is one among many fields that attempt to play a proactive role in communication and knowledge exchange environments. Objective: Therefore, this study aims to outline, from a historical context, the theoretical and methodological interactions existing between the concepts of classification and categorization as processes of representing the universe of knowledge to achieve OC for different audiences, that is, from a Librarianship and CI perspective. Methodology: It is characterized as exploratory and descriptive research based on a bibliographical survey, materialized by a narrative literature review. Results: With the input obtained in this survey, we analyzed the theoretical foundations, characteristics, and relationships, discussed the universe of knowledge concerning KO, and distinguished, along the way, the concepts of classification and categorization. Conclusion: It was found that these two processes comprise part of the KO, with classification starting from the characteristics of an organization and finalizing with categorization focusing on the properties of an object or phenomenon.

KEYWORDS

Organization of knowledge. Classification. Categorization.

Universo do Conhecimento: classificação e categorização sob o prisma da organização do conhecimento

RESUMO

Introdução: A organização do conhecimento (OC) é um campo que desempenha papel proativo em ambientes de comunicação e de troca de conhecimentos, aqui considerado um calcado no processo de classificar e categorizar as ciências e o conhecimento. Objetivo: O objetivo deste estudo é delinear, a partir de um contexto histórico, as interações teóricas e metodológicas existentes entre os conceitos de classificação e categorização como processos de representação do universo de conhecimento para que se alcance a OC para públicos diversos. Metodologia: Caracteriza-se como uma pesquisa exploratória e descritiva, utilizando um levantamento bibliográfico,

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materializado por uma revisão narrativa de literatura. Resultados: Com insumos obtidos nesse levantamento, analisamos as fundações teóricas, características e relações, discorrendo sobre o universo do conhecimento em relação à OC, distinguindo, nesse percurso, os conceitos de classificação e categorização. Conclusões: Constatamos que esses dois processos compõem a OC, sendo as teorias e princípios desenvolvidos nesses estudos fundamentais para todos os aspectos da OC; enquanto a classificação impõe uma estrutura mais estável e rigorosa para organizar entidades, a categorização pressupõe certa flexibilidade, sem delimitações muito rígidas de suas fronteiras.

PALAVRAS-CHAVE
Organização do conhecimento. Classificação. Categorização.

CRediT

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JITA: ID. Knowledge representation.
ODS: 4. Quality education

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1 INTRODUCTION

Man is driven by curiosity since childhood because questions help him discover new ways of thinking and representing a given object. Aristotle (1984, p. 11) already stated that "all men have by nature a desire to know" and this knowledge can be built by observing the attributes and characteristics of the object, in addition to what refers to the (non-empirical) preconception about the object. Thus, knowledge begins at the level of ideas, through the processing of the mind based on cognition, and through the logical conclusions of this process.

Human learning is based on the ability to analyze, represent, and organize data, information, and knowledge. Therefore, we organize ourselves to retrieve it. To achieve this, we need to create mechanisms to standardize and represent this knowledge, which is recorded in an information resource. This allows the knowledge to be shared later between individuals within a specific context, contributing to the process of knowledge organization.

Knowledge Organization (KO) is one of the many fields trying to play a proactive role in communication and knowledge sharing environments. It has its roots in the movement to classify the sciences and knowledge. It takes us back to Aristotle, the first philosopher to think about the world and propose to categorize it, creating the ten categories to represent it. However, although the term “knowledge organization” was used by Bliss (1933), Soergel (1971), and Dahlberg (1973), it only began to be discussed in the Library and Information Science (LIS) community in the early 1990s. Until then, studies had focused exclusively on classification within the framework of the Classification Society, which was founded in the 1970s. This association was disbanded in the late 1980s and the International Society of Knowledge Organization (ISKO) was born, which began to adopt the term “Knowledge Organization” as a discipline and field of study in IC. As a discipline, KO is considered broader and can encompass the whole framework of how knowledge can be understood, organized, described, and represented so that it can be appropriately accessed and made available to anyone who seeks it. Thus, for the KO community, classification is considered a method of organizing knowledge into classes and groups according to predetermined criteria (Dahlberg, 1993).

As a field of study in librarianship and IS, KO deals with the organization of recorded knowledge, emphasizing that "organization in information activities means classification in its broadest sense", which includes "indexing (assigning a subject class or aspect to a document/resource), classification schemes (with or without notation), terminology, thesauruses, taxonomies, and the like" (Gomes, 2017, p. 35). In discussing this, Santos, Neves, and Souza (2019, p. 96) state that the processes of KO, "associated with the practices and techniques of representation of records, have contributed to the emergence of KO as a field of theoretical and applied studies essential in the context of information science." Gomes (2017, p. 54) points out that in KO "ordering is fundamental"; and it is possible to "understand this activity with classification as a central component", adding that we have "in the present time two significant [...] moments [...]: - Schemes influenced by proposals to classify the sciences by philosophers and scientists; - Faceted schemes". The author points out that, with Ranganathan, classification "adopts a categorical principle to cut out each class in its scheme" (Gomes, 2017, p. 57). This may explain why the terms "classification" and "categorization" are often used interchangeably in library science and IC literature, for

example, in Lancaster (2004), Vickery (1980), and Jacob (1991). At other times, for example in Jacob (2004), Estes (1994), and Pommerening and Bisang (2017), the two terms are mentioned as a field of knowledge or as a process. However, we must understand that in both cases, classification and categorization refer to the context of representing the universe of knowledge so that KO is possible. The universe of knowledge "can be defined as the totality of ideas, facts, fictions, myths, experiences, and emotions expressed and preserved by society" (Satija; Martínez-Ávila, 2017, p. 86). According to the authors, "knowledge is essentially public" and "depends on the knower," and "all the different pieces of knowledge can be unified into a great whole" (Satija; Martínez-Ávila, 2017, p. 86).

That said, this study aims to outline, from a historical context, the theoretical and methodological interactions that exist between the concepts of classification and categorization as processes for representing the universe of knowledge to achieve KO for different audiences; in other words, from the perspective of Librarianship and IC. As a methodology, we propose an exploratory and descriptive study based on a bibliographic survey from a narrative literature review. This type of review seeks to read the literature critically, using an arbitrary selection of documents based on the knowledge and expertise of the authors, without the need to apply an explicit and systematic search strategy (selection of keywords and formulation of strings) (Rother, 2007). The search, therefore, included the terms "classification" and "categorization," always combined with terms such as "history" and "philosophical principles."

Documents were collected from specific and multidisciplinary sources of data on the topics discussed (including the PERI Database, Information Science Database - BRAPCI, Knowledge Organization Magazine, Scientific Electronic Library Online - SciELO, Elsevier Science, Web of Science - WoS, UFMG Library System, and Dimensions), as well as bibliography from the authors' collections. The inclusion and exclusion criteria were based on the following elements: no time or document type restrictions, digital or printed access to the documents, and publications in Spanish, English, and Portuguese.

With the inputs obtained from the literature review, we analyzed all the material using the three main stages of the content analysis method: a) pre-analysis (literature exploration), b) material exploration, and c) treatment of results, inference, and interpretation, without using quantitative indicators. In the pre-analysis and material exploration stages, we examined the theoretical foundations, characteristics, and relationships, discussing the universe of knowledge about KO and, along the way, distinguishing the concepts of classification and categorization. In the final stage of interpretation, we created a table of the constituent elements of classification and categorization, relating the two issues to the organization of knowledge. In the following sections, we will discuss the universe of knowledge, including the KO, classification, and categorization. We will try to describe the interactions between the fields in a historical context, their mutual contributions to their evolutionary developments, and the final considerations.

2 THE UNIVERSE OF KNOWLEDGE

As we learn, new structures and connections emerge, adding information to existing structures or changing them through the process of restructuring (Lima, 2018). Each knowledge structure exists as an object, idea, or event and as a group of attributes that are

linked to another knowledge structure. These knowledge structures are representations of the organization of ideas in our semantic memory, which is responsible for the long-term retention of information. To this end, according to Moreira (1993), the structuring of knowledge in the human mind tends to follow a hierarchical structure, starting with the most comprehensive ideas.

It is known that since Plato and Aristotle's time, there has been a concern about naming, defining, and categorizing philosophical knowledge. The nature of concepts, their representations, how we recognize examples of specific concepts, and how we interpret them are among the most studied issues, initially in Philosophy and later in Cognitive Sciences, Librarianship, and Information Science so much so that Lakoff (1987) recognizes that "conceptual categories have been much studied in detail in the Cognitive Sciences, specifically knowledge about the mind," which, according to the author, "comes from various academic disciplines, including Psychology, Philosophy, Linguistics, Anthropology, and Computer Science" (Lakoff, 1987, p. xiv).

Satija and Martínez-Ávila (2017, p. 89) state that "each era and society has a different view of the structure of knowledge" because "the prevailing philosophy, material culture, economic and technological needs, cosmic vision, sense of history and values held by society influence the limits, status, and structure of the stock of knowledge in its possession." The authors point out that, "in the Middle Ages, theology was considered the queen of the sciences (...). Even at the time of Melvil Dewey (1851-1931), at the end of the 19th century, philosophy and theology occupied a very respectable position" (Satija; Martínez-Ávila, 2017, p. 89). This may explain why a fifth of Dewey's "universe of knowledge was occupied jointly by these two classes," and the authors warn that, "today, the balance is tipping towards the study of the natural sciences and their economic and technical implications" (Satija; Martínez-Ávila, 2017, p. 89). Still talking about the universe of knowledge, the authors state that "subjects that were once important and were at the center of knowledge are now relegated to a peripheral position," with "management of environmental studies, biotechnology, and research into unconventional energy sources (...), resource management, human/animal rights, information technology, biotechnology and environmental protection now being important" (Satija; Martínez-Ávila, 2017, p. 89).

From the perspective of the universe of knowledge, Satija (2008) defines knowledge "as the total of recorded ideas, facts, fiction, myths, experiences and expressed emotions preserved by society [...] it is known by society and kept in its collective memory" (Satija, 2008, p. 7). The author further elaborates that "knowledge is essentially public, [...] tacit [...] formed by knowledge and experience", and "is dependent on the knower, [...] creator and consumer of knowledge", being "a living system, with its own defined characteristics" (Satija, 2008, p. 7). Among these characteristics, the author emphasizes that knowledge is not independent of the knower (it is subjective and originates from the mind); it has a social character; it is fragmented, dynamic, multidimensional, and changeable; it is infinite; the use of knowledge, technology, and social advances are interdependent; the senses perceive and interpret information and data that is transformed into knowledge. This dual nature of public and personal knowledge adds a layer of richness to its understanding.

Sen (2009) points out that the universe of knowledge was formed by creating and recording human beings' observations, experiences, and reasoning in a continuum. For the author, the universe of knowledge has several characteristics: it is made up of dispersed segments; it is successive and continuous; it is infinite, multidimensional, dynamic, and expandable; its integral component is action; it is flexible; segments can

merge to form a new segment (e.g., biochemistry); segments can be grouped without each segment losing its identity (e.g., oceanography).

Discussing how to understand the essence of segments, Sen (2009) highlights their characteristics, indicating that the segment originates when we establish a subject that is not stagnant in its shape and size since it changes over time, showing its dynamism. The author indicates that any of the segments (subjects) can be presented in four sets:

1) Segments as Objects: they include all nouns except those relating to space and time and can be concrete (an author), abstract (mathematics), animate (tiger), or inanimate (mineral). All these nouns can have qualifiers (pig iron; theoretical physics).
2) Segments as Action: encompass all verbs as a noun phrase (diagnosis,
3) treatment, classification, cataloging), which can also have qualifiers (X-ray diagnosis, heat treatment, broad classification, rapid cooling, slow burning).
4) Segments such as Space: encompass all geographical spaces (India, Delhi) and astronomical spaces (sky, space), which can also have qualifiers (north India, south Delhi, blue sky, dark space).
5) Segments such as Time: encompass all manifestations of time (century, year, month, season), which can also have qualifiers (20th century, calendar year, productive month, spring).

Sen (2009) adds that each segment is a subject with its identity and is treated from a specific space (the same subject can be treated from different places and angles). The author assures that in the universe of knowledge all segments are interconnected, and sometimes, in a given space and time, two or more segments can become more robust and merge into a new segment (biochemistry). The researcher also notes that segments can be: a) well-formed: "recognized by academic bodies and taught in academic institutions, e.g. physics"; b) in formation: not yet fully "recognized by the academic community and in the process of finding a place in the school or university curriculum" (emerging subjects); and c) in nebulous formation: "despite having a more or less identifiable size and shape, they are not generally recognized by the academic community", "such as astrology and palmistry" (Sen, 2009, p. 8). The author points out that a segment can also be subdivided (cut out of a given reality) and share part of its content without losing its identity or essence, since each segment (subject) goes through "the stages of creation (sristi), stability (shtiti), and decay or destruction (laya)" (Sen, 2009, p. 8).

2.1 Knowledge Organization

In the definitions proposed by Dahlberg, KO is always presented as a discipline. Dahlberg (1993, 1995, 2006, 2014) believes that KO is an autonomous discipline independent of Library Science and IC, characterizing it as a subfield of the sciences. For the author, information is "knowledge in action," and she considers that "knowledge is ordered and information is digested" (Dahlberg, 1993) because, in her words, KO is

> the well-founded certainty, subjectively and objectively, that someone has about the existence of a fact or a subject. This knowledge is not transferable; it can only be developed through personal reflection (Dahlberg, 1995, p.10).

This perspective points to the dependence of knowledge on the human cognizing. For the author, the term "knowledge organization" denotes its object of study

subject. (knowledge) and its area of activity (organization) in the name itself, which makes it a scientific discipline. Dahlberg (2006) states that KO

> means the construction of conceptual systems. The science that systematically structures and organizes units of knowledge (concepts) according to their inherent knowledge elements (characteristics) and the application of these concepts and classes of ordered concepts to objects/subjects. (Dahlberg, 2006, p.12).

What is clear from this statement is that our knowledge is condensed from the information content of concepts, and that these concepts are units of knowledge that form the elements of a knowledge system. To build this type of system, the author develops the Analytical Concept Theory, which, according to the author, is essential in "all terminological work" (Dahlberg, 1978, p. 142). Dahlberg (1992) points out that to create new knowledge, it is necessary to systematize existing knowledge about something portrayed in concepts.

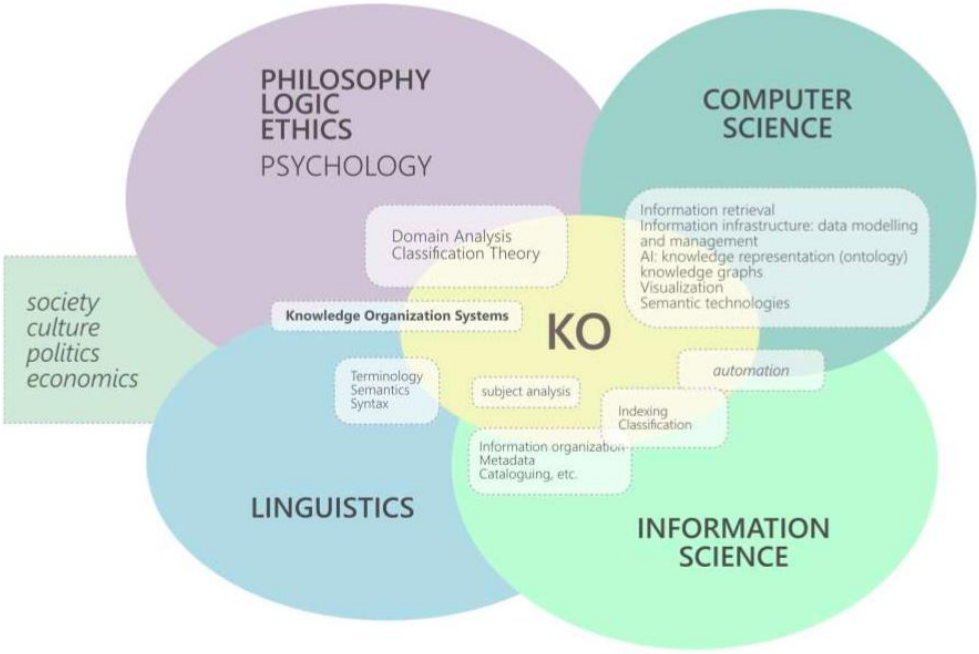
Continuing his studies, in 2014, Dahlberg stated that KO

> presupposes, on the one hand, knowledge of the concepts/units of knowledge being analyzed, as well as of the questions of the theoretical system connected with the structuring of concepts and classes of concepts, so that, as a result, ordering schemes acceptable to the scientific world are obtained (Dahlberg, 2014, p.88).

From this angle, the author considers KO an abstract process, as it refers to the concept. However, v inculcated the study of conceptual structures that represent a conceptual ordering of knowledge.

Dahlberg (1993, 2006, 2014) emphasizes that KO is a meta-science that operates in all fields of knowledge. It relies on these other fields to be conducted simultaneously as it supports these fields, making it a more open science. For this reason, Smiraglia (2014) points out that "the discipline we know today as KO is the sum of the research conducted on the conceptual ordering of knowledge and on the connection between disciplines that allows us to see their effective knowledge" (Smiraglia, 2014, p. 3). From this perspective, KO is interdisciplinary because it is intertwined with different disciplines, such as library science, IC, computer science, cognitive science, anthropology, philosophy, linguistics, psychology, and sociology, among others, which deal with different aspects of KO, the diversity of which expands the conceptual boundaries to meet the new challenges of society. To illustrate this interdisciplinarity, we show the example of Slavic's (2022) proposal, which presents the processes, products, and skills that come from the field of KO and the boundaries where the different aspects occur. At the same time, the author uses theoretical contributions from the border areas, as shown in Figure 1.

Figure 1. Organization of knowledge and border areas



Source: Slavic (2022, p.9).

Given the above, cognitive aspects are also present in KO. According to Mey (1982), cognitive science studies what knowledge is and how it can be represented and manipulated in its most diverse forms. From the cognitive perspective, we know that the concept is the central element of KO and is developed through the individual's action on particular objects that exist in the world based on their cognitive understanding in a given socio-cultural context.

In this way, concepts are dynamically constructed units of knowledge, and their meanings are shared. These concepts can be organized in a structured way, and this requires a cognitive process involving the manipulation and processing of symbolic representations, which must exist somewhere. Thus,

> the cognitive perspective of information science implies that each act of information processing, whether perceptual or symbolic, is mediated by a system of categories and concepts that constitute a model of the world for the information processing mechanism (Mey, 1982, p. 4).

To this, the cognitive process appears both in analyzing and identifying a document's content and in the mental process between stimulus and response that transforms information into knowledge and vice versa. Cognitive aspects play a fundamental role in KO, both in the assimilation and representation of knowledge and in the way this knowledge transforms and meets the user's needs. As a human activity, KO is linked to cognition in social, professional, and intellectual actions, as it is part of daily human life.

From Hjørland's (2008) standpoint, KO can be seen from two perspectives: broad and narrow. From a broad perspective, the author considers KO to be linked to the social division of mental labor and the production and dissemination of knowledge, and is thus concerned with how knowledge is socially organized and reality is organized.

From a narrower point of view, the author states that KO is treated more pragmatically, suggesting that its focus is on the processes of "describing, representing, archiving and organizing documents and representations of documents, as well as subjects and concepts, both by humans and by computer programs" (Hjørland, 2008, p.86). From these two perspectives, the role of KO is to help users navigate information spaces, retrieve documents, make decisions for future research activities, and visualize information resources.

Hjørland (2002, p. 258) also brings the Domain Analysis Theory into the scope of KO, explaining that its central point is "that tools, concepts, meanings, information structures, information needs, and relevance criteria are shaped in discourse communities" since it is there that "an orderly and delimited communication process takes place. “Thus, applying this theory to KO, the essence of the "analysis lies within the community of discourse, in which the flow of information seeks a practical sense of production, communication and use," approaching "pragmatism, which embraces the idea that truth lies in the sense of utility, in the practical conception of things, that is, any act, object, or proposition must be useful or generate a practical effect" (Maculan,2014, p. 147).

Hjørland (2016) states that KO is a research, teaching, and practice field mainly affiliated with Library Science and IC. To these ends, KO develops rules and standards, including classification systems, thesauruses, and other knowledge representation tools.

Ranganathan (1967) also provided input for understanding KO, establishing the multidimensional meaning of knowledge and explaining it through the idea of the" Banyan Tree," suggesting the idea that subjects (segments in the universe of knowledge) can interrelate in complex and unforeseen ways. From this perspective,

> the division methods for organizing knowledge are based on categories that are thought of in terms of their conceptual scope, which are not only related to one core but to several, depending on how the units of knowledge are related (Maculan, 2014, p. 119).

In Librarianship and IS, the term "knowledge organization" is often used interchangeably with the term "information organization," or even merged as in "knowledge and information organization," as pointed out by Hjørland (2012), and can be approached either as a process or as an autonomous discipline. An example cited by the author is the title of Elaine Svenonius' book (2000), entitled The Intellectual Foundations of Information Organization, in which the author does not use the term knowledge organization. This difference in nomenclature is cited in the literature by various authors, such as Smiraglia (2014) and Hjørland (2003, 2012). Despite this multiplicity of terminology, in Library Science and Information Technology, these expressions are primarily used with the same meaning.

Henry Evelyn Bliss (1929, 1935) was the first researcher to write about knowledge organization. Bliss (1929) presents KO from an intellectual and social approach, defining KO in five stages

> (1) the descriptive or expository, related to individual knowledge, in its mental or psychological aspect; (2). the classificatory or analytical, the social organization of knowledge, that which belongs to a community of social minds, i.e., in an educational field, a science or an art; (3) the synthetic or systematic, that which is part of a branch of knowledge, in an idea or topic embodied in a book or other form of oral or written language; (4) the educational or cultural, the social organization of a field of knowledge in a class of books, in a specialized library, in a museum or exhibition and (5) the

> librarian or bibliographical, the organization of many or all fields of knowledge in a conceptual, scientific, intellectual, educational and cultural system in a body of literature, in an encyclopedia or a general library (Bliss, 1929, p.78).

Bliss (1929, 1935) considers that the sciences tend to reflect the order of nature, and bibliographic classification should reflect the order of knowledge, as discovered by science, and Hjørland (2008) suggests the following sequence: natural order → scientific classification → bibliographic classification.

When referring to the background, Hjørland (2008, p. 89) clarifies that KO is sometimes identified with the label "traditional approach." In this approach, according to the author, there are some principles, among which are (1) the principle of controlled vocabulary, (2) Cutter's rule on specificity, (3) Hulme's principle of literary guarantee (1911), and (4) the principle of organization from the general to the specific.

From this perspective, classification, and categorization are presented as processes for representing the universe of knowledge to achieve KO for different audiences, in other words, from the Library and Information Science perspective.

2.2 Classification

Classification has been practiced since the dawn of thought; since the dawn of man, man denotes thinking. So much so that Bowker and Star (1999, p. 1) observe that "classifying is human." Human beings classify objects almost by instinct and unconsciously, and add that although classification is considered an ancient activity, it can also be considered modern because it is still necessary. Dahlberg (1979, p.352) says that "the ancient art of classification, as old as mankind, has only recently acquired an adequate theoretical basis - a basis which allows us to assume that it has progressed from the status of an art to that of a science. “While classification is a process of ordering and differentiating elements in a universe, it also mirrors philosophy, having its terminology.

The influence of philosophy on bibliographic classification is undeniable. The development of bibliographic classification systems has been significantly shaped by philosophical classifications. This interplay between philosophy and bibliographic classification is a testament to the interdisciplinary nature of the field, with the philosophy of bibliographic classification encompassing the general principles of knowledge.

For this reason, historically, bibliographic classification has been considered an evolution of knowledge classification, with some adjustments to consider the representation of the content of documents. Representing this premise, Ranganathan (1965) provides a definition made up of eight groups, namely:

> (1) concrete materials; (2) perception - that which is, facts of sensory experience; (3) facts recorded in meta-documents - that is, records of direct instruments of natural and social phenomena not mediated by the human mind; (4) concepts - that is, facts of intellectual experience; (5) concrete concepts - that is, concepts having concrete materials outside the mind as their correlates; (6) abstract concepts - that is, concepts that do not have concrete materials outside the mind as correlates; (7) mystical and spiritual experience - that is, trans-intellectual experience; and (8) combination of any of these (Ranganathan, 1965, p. A1).

Ranganathan notes that the term "classification" can be used in relation to any Existence—concrete or conceptual. He adds that group 1 is far removed from the other six and suggests using the term "knowledge" to denote these groups. For the author, a

distinction can be made between bibliographic classification and knowledge classification, which, although related, are distinct.

Other definitions in the literature take various approaches, such as the one proposed by Ranganathan. One of them is by Shera (1965), who presents four different approaches that the definition of classification can cover:

> (1) Classification is the crystallization or formalization of inferential thought, born of sensory perception, conditioned by the operation of the human brain, and shaped by human experience. It is the basis of all thought, but is pragmatic and instrumental. (2) The act of organizing real things ... so that they represent the abstract arrangement in a practical classification. (3) The written or printed schedule of terms representing a classification system. This is called a classification scheme. (4) The act of placing objects or books in their proper places in the classification scheme. That is classification." (Shera, 1965, p. 120).

The author makes an apparent distinction between the approaches that the term classification can represent, which, despite the similarity, helps to elucidate the meanings.

Along the same lines as Ranganathan and Shera, four decades later, Ingetraut Dahlberg (2010) presents four meanings of the word "classification", including the following concepts:

> 1. classification in the sense of 'classification system', i.e., a system of classes organized in a hierarchical or faceted order;2. classification in the sense of classifying, i.e., establishing a system of classes; 3. classification in the sense of classifying, i.e., relating the classes of a classification system to objects or subjects in reality; and 4. classification in the sense of the science of classification, i.e. relating to this field of study and its activities "(typographical list added" (Dahlberg, 2010, p. 2941).

However, not all authors agree with these definitions, which are based on various approaches, preferring to use the approach of the principle of dichotomy between similarities and differences, thus causing various controversies. Thus, there are various definitions of classification in the literature of the area. Some authors approach it as a division process, others as a system for representing knowledge, and others as a discipline. However, eventually, all approaches point to the classification, ordering, and organization of information to generate knowledge based on propositions and principles developed in association with practice.

On this issue, Hjørland (2017) points out that different theories result in different classifications, citing that empiricists and positivists argue that the data speaks for itself, while hermeneutic researchers assume that the interpretation of the data itself always reveals theoretical influences. The author also mentions that pragmatic and critical approaches consider the objectives, values, interests, and consequences involved, serving explicit interests, and are never neutral, with particular purposes. Therefore, the classification objectives will guide the philosophical approach to classification modeling.

According to Garcia Marco and Esteban Navarro (1993), from a cognitive perspective, understanding the nature of these processes implies collecting experiences through meanings, which are then processed and formalized into concepts and discourses through a process that includes, firstly, classifying, distinguishing between elements, grouping them by relevant dimensions and building comparison criteria. Secondly, it involves ordering, placing, connecting, and relating elements along spatial, temporal, and other dimensions. Thirdly, it involves organizing, storing, preserving, and deleting elements, establishing relationships according to different criteria, and building a knowledge system that becomes more and more complex.

In this way, classification requires decisions based on the user's familiarity and understanding of similarity and on difference and identity in terms of "this is, that is not." Thus, in the categorization process, both conceptions must be kept in mind because they consider the natural processing in the minds of humans who categorize mainly by basic concepts and analogy. For this reason, classification is considered a theoretical basis and an essential method for organizing knowledge.

We will now describe categorization to highlight this difference, analyze it in the context of knowledge organization, and relate it from the Librarianship and IS perspective.

2.3 Categorization

Since the time of Aristotle, there has been concern about naming, defining, and categorizing practices. Cognizable information is fundamental in defining the dimensions of a category because categorization is not done artificially but by considering information from the universe in which we live and how we respond to it. Recognizing similarities and differences in categorization leads to creating new knowledge by grouping entities according to the observed similarities and differences. Corroborating this concept, Hjørland (2017), discussing the ideas of Elin K. Jacob, reports that categorization is flexible and establishes non-binding associations between entities based on the simple identification of similarities. In this way, it is possible to establish that categorizing is grouping entities (objects, ideas, actions, etc.) by similarity at a higher level of abstraction.

Quoting Schmidt and Wagner (2004), Hjørland (2017, p.) points out that categorization is a linguistic operation of assigning categories or concepts to specific phenomena distinct from the mere act of seeing and recognizing. Hjørland (2017) adds that categorization is a process that emphasizes specific world characteristics, breaking them down into pieces and highlighting the pertinence of entities to specific categories.

From the perspective of cognitive science, Lakoff (1987, p. 5) states that,

> Most of our words and concepts designate categories [...] categorization is not a process to be studied superficially. Nothing is more basic than categorizing our thinking, perception, action, and speech. Every time we see something as "a type" of thing, for example, a tree, we are categorizing. [...] Understanding how we categorize is central to understanding how we think and function and, consequently, to understanding what makes us human (Lakoff, 1987, p. 5).

In the same vein, Howard Gardner (1996, p.373) states that "categories have an internal structure, centered on prototypes or stereotypes, and other exemplars are defined as more or less peripheral, depending on the degree to which they share crucial characteristics with the central prototype". Jacob and Shaw (1998) say that "categorization is a cognitive process of dividing experiences of the world into groups of entities, or categories, to construct a physical and social order of the world"

In Iyer's view (1995, p. 41) "categorization then becomes not a structure for defining the universe, but rather a process for providing subsidies for thinking, momentarily useful for grouping by association", thus indicating the appropriation of the ideas established by Wittgenstein together with the contributions of cognitive studies for the development of Categorization in IC. Markman (1989)[1] Jacob and Shaw (1998, p.

[1] MARKMAN, Ellen M. (1989). *Categorization and naming in children*: problems of induction. Cambridge, MA: MIT Press. 250 p.

155) quote categorization as "a fundamental mechanism that simplifies individual interaction with the environment: not only facilitating the storage and retrieval of information but also reducing the demand on human memory."

Historically, there have been two views on Categorization. In philosophy, the classical view dates back to Aristotle. For both Plato and Aristotle, concepts are defined by their essences. While Plato's study focused on ideal forms, which distanced him from the scientific theory of concepts, many scholars in the mid-20th century based their studies on Aristotle's ideas, treating concepts as being defined by a set of necessary and sufficient characteristics, which were discovered empirically, being a proposal of representation rather than process. Some consider Aristotle's classical theory to be the perfect hierarchy of the world. In it, categories are defined only by the properties common to all their members.

The other view, prototype theory, was proposed by Eleanor Rosch in the 1970s to explain the shortcomings of the attribute definition point of view. It is tough to draw clear lines between the points of view of each model and where they are most satisfactory. It is not the aim of this study to go into this perspective, so for more information, we suggest consulting the literature in the area[2].

It can be concluded that the functions of categorization from a cognitive standpoint are: (a) to classify, which is the function that allows the mind to contact the world; (b) to support explanations and ensure prognosis about the future, which can be used to select plans and actions; (c) to support the mind, since there is no need to store all the facts and their possibilities, if inferences can be derived from information already stored (Medin; Ross, 1996).

3 REFLECTIONS ON THE CONSTITUENT FIELDS OF CLASSIFICATION AND CATEGORIZATION FROM THE PERSPECTIVE OF KO

In the previous sections, we expanded on the classification characteristics and categorization of knowledge to highlight their contributions to KO. In this section, we reflect on the interactions between the areas within a historical context, promoting analysis of the elements that make up and characterize these two processes and their interactions with KO, based on their areas of origin and the contributions of the reference authors, to observe their constituent elements, namely: (1) areas of knowledge, (2) reference authors, (3) theory, (4) object of study, (5) methods and processes, (6) approach and (7) contributions and products produced, as shown in Chart 1.

[2] LIMA, G. A. B.O. Modelos de categorização: apresentando o modelo clássico e o modelo de protótipos. *Perspectivas em Ciência da Informação*, v.15, n.2, p.108-122, maio/ago. 2010.

Chart 1. Elements of the constituent fields of categorization and classification from the perspective of knowledge organization

FIELD OF STUDY	AREAS OF KNOWLEDGE	REFERENCE AUTHORS	THEORY	OBJECT OF STUDY	METHOD AND PROCESSES	APPROACH	CONTRIBUTIONS/ PRODUCTS
CLASSIFICATION	Philosophy	Porphyry of Tyre (232/233-ca. 304)	Classification theory	Universals (something capable of being predicated of many)	Logical division/division principle (Abstraction/grouping/Ordering of entities into classes in hierarchical structure)	Realism and nominalism	Logical model of the "Porphyry Tree"
	Librarianship	Ernest Cushing Richardson, (1860-1939)	Theoretical principles for bibliographic classification	things (including ideas and physical objects)	Systematic division principle and classification for ordering, based on the similarity of the simplest to the most complex.	Pragmatics and analytical (with ontological and epistemological order)	Theoretical basis for bibliographic classification based on the principles: law of similarity and law of evolution (historical)
		Henry E. Bliss (1870-1955)	Classification theory (philosophical and theoretical context)	class-concept-term	Systematic method of inductive and deductive logic, through the coordination and subordination mechanism	Positivist, realistic, with a social nature	Theoretical basis for bibliographic classification/Bliss Classification (1935) 14 principles of scientific or logical classification

		S.R. Ranganathan, (1892-1972)	Faceted Classification Theory	Basic subject/Ideas (Unit of thought))	Analytical-synthetic method of faceted analysis; deductive method; logical division of knowledge	Logical-positivist, multidimensional approach to knowledge	Theoretical basis for faceted classification, Colon Classification. Five Laws of Librarianship
	Library and Information Science	Ingetraut Dahlberg (1927-2017)	Concept analytical theory	Concept (units of knowledge)	Based on Aristotelian logic, deductive and inductive method	Logical-positivist (true statements), normative and analytical	*Information Code Classification* (ICC), *Systematifier. Classification System of Knowledge Organization Literature* (CSKOL)
CATEGORIZATION	Philosophy	Platão (428/427 a.C. -348/347 a.C.)	Theory of ideas/forms	Universals: non-material (but substantial and immutable) abstract forms (or ideas)	Dialectic method	Realism, Idealism, dualism	Theories of ideas; Platonic dualism
		Aristóteles (384 a.C. - 322 a.C.)	Classical categorization theories, Theory of knowledge	The "essence" /substance/	Categorical/deductive logic, systematization	Empiricism, Realism, idealistic, with positivist thoughts	General classification of knowledge, categorical logic with 10 categories
	Cognitive Sciences	Eleonor Rosch, (1938-)	Prototypical theory	Concepts/categories /prototypical element	Non-systematic process, grouping by similarity	Cognitivism Empiricism, Interrelation	Prototype Model

	Library and Information Science	S.R. Ranganathan, (1892-1972)	Faceted Classification Theory	Analysis categories for subject formation (units of thought)	Categorization as a central and systematic process in the analysis and synthesis of subjects.	Logical-positivist, multidimensional approach to knowledge	Five fundamental categories - Personality, Matter, Energy, Space and Time (PMEST)
		Ingetraut Dahlberg (1927-2017)	Concept analytical theory	Categories, based on Aristotle, for organizing concepts (units of knowledge)	Based on Aristotelian logic, deductive and inductive method, categorization as a central and systematic process in the organization of concepts	Logical-positivist (true statements), normative and analytical	Set of categories: Entities (Phenomena, General Object, Material Object), Properties (Counting and measurement, Quality, Comparison), Dimensions (Time, Position, Space) and Activities (Operations, Processes, States).

Source: prepared by the authors (2024).

Analyzing the content shown in Chart 1 from the perspective of KO, the field of study of classification is considered in the sense of the process of classifying to represent the conceptual structure of existing knowledge in a domain. We begin with the area of knowledge of Philosophy, where we can highlight the influence of the studies of Porphyry of Tyre (232/233-ca. 304), which were the basis for the theory of classification, especially with his studies on universals, in the hybrid approach of Realism and nominalism. In terms of methods and processes, he worked with logical reasoning to abstract, group, and order entities into classes and subclasses, creating a hierarchical structure based on a definition scheme by successive dichotomies descending from the most general genus to the smallest species. Porphyry applied an essential realist approach, resulting in the logical model of the "Porphyry Tree," which "illustrates the logical classification of substance and can be considered the precursor of taxonomic classifications" (Maculan, 2014, p. 117).

In Library Science, three classifiers – Ernest Richardson, Henry Bliss, and Ranganathan – developed classification systems and presented the theoretical principles underpinning their proposals. These theorists systematized theoretical principles that influenced and contributed to the organization of multidimensional knowledge in contemporary KO studies.

With a solid positivist influence, Ernest Cushing Richardson (1860-1939) developed theoretical classification principles to support modifying and revising existing schemes. His studies focused on the connection between things (ideas and objects), since "the order of the sciences is the order of things" (Richardson, 1964, p. 24). The author uses systematic and classificatory processes to order things based on similarity, from the simplest to the most complex. The approach applied by the author is considered pragmatic and analytical, with his most significant contribution being his theoretical studies into the process of bibliographic classification, when the author suggests that classification should obey three principles: (1) the law of similarity, (2) the historical law and (3) the law of evolution, which together form his proposal for evolutionary classification.

Henry E. Bliss (1870-1955) is known for his relevant contribution to the development of the theoretical foundations of classification, in which the author brings the philosophical and theoretical context with studies on the concept, classes, and conceptual relationships, and the order of classes because, for him, "the concept is the residue of abstraction; the class is the totality of generalization" (Bliss, 1929, p.123). He used the systematic method of inductive and deductive logic through coordination and subordination, considering the natural order of reality and its various forms, including human conceptual activities. The author's approach is positivist, realistic, and socially oriented, indicating that education and science were the solutions to social problems, so much so that he considered that the basis for his classification system should follow the idea of educational and scientific consensus. For Bliss (1929, p. 411) "the classification considered best and most useful is that which is by the scientific system". From this argument, the author contributed to theorizing bibliographic classification as an organization of knowledge beyond the practice advocated within the constructs of Librarianship. Bliss was the first author to use the term Knowledge Organization. Among his significant contributions is the Bibliographic Classification system, which is regarded as one of the most perfect classifications in terms of structure and the subdivision of subjects with a faceted approach. In his first book, which was published in 1929 under the title The Organization of Knowledge and System of the Sciences, the author presents the theoretical foundation, through 14 principles, used in his classification, presenting the structure and relationship between the classes and the definition of the terms used, such as class, term, name, concept, group, among others.

Shiyali Ramamrita Ranganathan (1892-1972) is known for the development of the Faceted Classification Theory, with an analytical-synthetic approach, where the analytical phase aims to identify subjects (ideas-unit of thought and basic concepts) contained in mutually

exclusive documents and a synthesis phase of the identified elements, forming an exhaustive representation. The author proposes a multidimensional and more flexible way of looking at the universe of knowledge, suggesting a form of organization based on an unlimited polytomy, which he called the Banyan Tree. With this tree, Ranganathan proposes "a symbolic representation for knowledge, like a living organism, which is constantly growing and therefore undergoes ramifications, transformations, and development over time" (Maculan, 2014, p. 117). The tree establishes that subjects can be interrelated in complex and even unforeseen ways, generating new subdivisions, in other words, new classes and subclasses (Ranganathan, 1967), which is the multidimensional sense envisioned by the author. His significant contribution is the theoretical basis for faceted classification, with the facet method and analytical-synthetic principles, based on three levels of analysis: idea plane, verbal plane, and notational plane. He also contributed to the bibliographic classification system, Colon Classification, and the Five Laws of Librarianship, including several publications, including Prolegomena to Library Classification, in which the author presents his theory.

In the field of Library Science and Information Technology, the study of classification relies on the contributions of the Analytical Concept Theory of researcher Ingetraut Dahlberg since "influenced by the analytics, she develops her theory that provides secure bases for structuring hierarchies (logical relationships)." (Campos; Gomes, 2006, p. 355). (Campos; Gomes, 2006, p. 354), she is applying a logical-positivistapproach and a hybrid method (deductive and inductive). Above all, she contributed the Systematifier, a structuring model for the construction of classification systems, which determines that factual statements about an object (referent) are the logical way to arrive at generalizations about any domain of knowledge. The author created the Information Code Classification (ICC) and the Classification System of Knowledge Organization Literature (CSKOL) using these principles.

The field of study of categorization has its origins, initially, in two areas of knowledge: philosophy, with the studies of Plato and Aristotle, and Cognitive Sciences, with contemporary studies by authors such as Eleonor Rosch and George Lakoff, among others.

Plato (428/427 B.C.-348/347 B.C.) was concerned with studies on the essences of things (the universals). These concepts describe each existing being or object and their non-material (but substantial and immutable) abstract forms (or ideas). He contributed to the evolution of categorization through the Theory of the Idea (or of Forms), in which the philosopher postulates that actual knowledge lies in reason and that only fixed, and immutable ideas can describe an existing being or object. In other words, knowledge arises from an abstract reality together with the reality of ideas. This gave rise to Platonic dualism, characterized by the relationship between soul and body. Plato used the method of dialectic, known as Platonic dialectic, in which he referred to the act of thinking (reasoning), questioning, and hierarchizing ideas, with the extraction of a conclusion (synthesis) based on two opposing ideas (thesis and antithesis) (Nodori, 2004, p. 361). Considered a philosopher with a realist, idealist, and dualist approach, he is responsible for the creation of the so-called world of ideas and forms, founding metaphysical thought. He left behind around 30 published works, including The Republic, The Banquet, Apology of Socrates, Fédon, Lachesis, and Hippias Major.

Aristotle (384 BC - 322 BC) was influenced by the ideas of Plato, whose student he was. He is referenced for the greatness of his work in Philosophy, specifically for the field of study of categorization, presenting the Classical Categorization Theory, in which he proposes a view of representing the world of knowledge based on the classification and ordering of things in categories. To this end, the philosopher presents universals (general and abstract concepts) considering substance as the essential (primary) category: "substance is the first cause of being and, therefore, it is not the elements, but the formal structure that connects them" (Aristóteles, 2001, p. 42). Aristotle is considered an empiricist, realist, and idealist with positivist thoughts, whose most significant contribution was creating the logical system of thought known as categorical logic (or Aristotelian logic), which is essentially deductive. He proposed ten

categories, with substance being the basic (primary) category "substance is the first cause of being, and therefore it is not the elements but the formal structure that connects them" (Aristotle, 2001, p. 42), and nine more categories that are the first cause of being (Aristotle, 2001, p. 42). 42), and nine other categories that attribute to substance attributes that characterize it, namely: (1) quantity (extension), (2) quality (3) relation, (4) place (space) and (5) time/date/duration, (6) way of being, (7) action (activity), (8) passion/suffering, (9) position, contributing to the systematization of the general of knowledge, known as Aristotle's classical theory. These constructs influenced the development of classification studies and are considered the theoretical basis for the bibliographic classifications that began to emerge in the 4th century. His proposal for systematizing knowledge also served as the theoretical basis for studies on categorization in various areas of knowledge, especially in cognitive science.

Within cognitive science, we have the scholar Eleonor Rosch (1938-), who focused her studies on categorization in cognitivist terms. The author proposed the Prototype Theory because she questioned Aristotle's classical model. Its purpose was to study the characteristic attributes in the categorization process, verifying how the conceptual categories of objects are organized based on characteristic attributes that vary in degrees of typicality. For Rosch (1978, p.36) "the prototype is the mental representation of the category itself, attempting an ideal relationship between object and category". In this process of establishing an intercategorial hierarchy, starting from the most representative concept, sets of categories are formed which are organized in such a way as to form taxonomies, i.e., systems where elements are linked to each other by the inclusion of classes, in an empiricist, cognitivist and interrelation approach. With her studies, Rosch contributed to categorization gaining visibility as a subject of scientific investigation, becoming a field of study within cognitive science, mainly due to her proposal of the Prototype Model.

Still within the field of categorization studies, coming from the area of Library Science and IC, we have the contributions of Ranganathan and Dahlberg. Ranganathan proposes five fundamental categories (PMEST): Personality, Matter, Energy, Space, and Time, as a way of representing knowledge dynamically and analytically, in continuous growth, in a multidimensional approach based on the method of deductive logic. The central method and process for forming subjects (units of thought) contained in documents is Categorization (PMEST), using a logical-positivist and multidimensional approach to knowledge. The categories established by the researcher are very similar to Aristotelian categories, but Ranganathan does not propose an analysis based on ontology but rather on knowledge records.

Dahlberg, in turn, developed the Analytical Concept Theory, a set of categories and subcategories based on Aristotle, used to organize concepts into conceptual systems: Entities (Phenomena, General object, Material object), Properties (Counting and measurement, Quality, Comparison), Dimensions (Time, Position, Space) and Activities (Operations, Processes, States). The researcher argues that "categories group concepts based on particularities related to the areas of knowledge or activities in question", and "that the predication of a referent can result in only four types of characteristics to determine its scale of specificity (from the most general to the most specific)" (Maculan, 2014, p. 124-125). Hers studies were based on Aristotelian logic, deductive and inductive representation methods, with analytical, logical-positivist, and normative characteristics.

Having established the constitutive fields of classification and categorization, we turn our thoughts to analyzing these elements from the perspective of the field of KO studies, which we can consider having its origins in the areas of Philosophy, Cognitive Sciences, Library Science, and Information Science.

In classification and categorization studies, the theories and principles developed in these areas are fundamental to all aspects of KO, and we owe the theoretical foundations to the knowledge derived from Philosophy. While classification imposes a more stable and rigorous structure in arrangements of entities and objects with predetermined criteria and purposes,

categorization presupposes a certain flexibility, which considers not very rigid delimitations of its boundaries and can be adapted to the specificities of different contexts (Jacob, 2004). This way, classification, and categorization converge to guide the KO of any domain and knowledge records.

Both Ranganathan and Dahlberg, specifically from the fields of Library and Information Science, introduced the theoretical contributions of Philosophy into theoretical-methodological constructs for the processes of classification and categorization; in other words, they added theoretical support to the processes and instruments.

Dahlberg formulated Concept Theory, based on the use of the concept as a unit of knowledge for representation purposes, anchored in Ranganathan's Faceted Classification Theory and Eugen Wüster's (1898-1977) General Theory of Terminology (GTT), based on its principles and methodological guidelines for processing terminological data, considering the technical-scientific term as a unit of thought, which expresses concepts and not meanings, i.e. it first establishes the concept and then defines which linguistic expression will represent it (Wüster, 1974; 1981), as well as its principles for creating specialized languages and concept systems.

We would also like to highlight the contribution of Cognitive Sciences to KO, since "categorizing things is inherent to human beings", since "the brain shapes the structures that mirror the external environment in a categorical form," and "if we do not interact with the environment, we will not have anything to classify" (Lima, 2003, p.79). In this area, the prototype model, with Rosch's studies, is relevant to KO since it highlights the issue of Categorizing as a field of study in cognitive sciences.

4 CONCLUSION

Based on the constituent elements that support classification and categorization, explained in Chart 1, we can see that these two processes are part of knowledge organization. Organizing knowledge involves analyzing the philosophical logical, and cognitive studies that underpin the correspondence between the object and its representation.

The literature sometimes shows a certain inconsistency in terminology, since "categorization" and "classification" are sometimes used interchangeably. As we have seen, Jacob (2004) explains that while traditional classification is strict in terms of the criteria established for an entity to be a member of a particular class, the categorization process is flexible and creative and can delineate disordered associations between entities, starting from the simple recognition of similarities existing in a set of entities. We can infer that classification starts from the characteristics to organize, and categorization focuses on the properties of an object or phenomenon.

In this study, we have brought elements to reflect on classification and categorization from the perspective of KO. However, this reflection does not end with this study since it is one of the authors' views and is therefore not considered exhaustive or exclusive. We hope the discussions made here will serve as elements for further reflection.

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