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Article

Knowledge Organization Systems: definitions, typologies, characteristics and instruments — a mapping and analysis of the literature

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Abstract: This study aims to analyze the definitions of the term Knowledge Organization Systems (KOS) in the literature, as well as their typologies, analytical models, and characteristics in the contemporary context. A Systematic Literature Review (SLR) was adopted as the methodological procedure, resulting in a corpus of seven articles aligned with the research objectives. The results highlight the terminological diversity associated with KOS, the lack of consensus regarding their conceptual delimitation, and the multiplicity of typologies and analytical models. It is observed that KOS encompass structural, functional, and contextual dimensions that broaden their understanding as instruments for information organization and retrieval. Furthermore, these systems do not follow a linear evolutionary logic but rather a process of continuity, reconfiguration, and integration, especially in digital and interoperable environments. It is concluded that the analysis of KOS requires approaches that consider their multidimensional, sociotechnical, and contextually situated nature.

Keywords: Knowledge Organization Systems; Knowledge Organization; Typologies; analytical models

Sistemas de Organização do Conhecimento: definições, tipologias, características e instrumentos — mapeamento e análise da literatura

Resumo: Este estudo tem como objetivo analisar as definições do termo Sistemas de Organização do Conhecimento (SOC) na literatura, bem como suas tipologias, modelos analíticos e características no contexto contemporâneo. Adotou-se como procedimento metodológico a Revisão Sistemática da Literatura (RSL), a partir da qual foi constituído um corpus de sete artigos alinhados aos objetivos da pesquisa. Os resultados evidenciam a diversidade terminológica associada ao termo SOC, a ausência de consenso quanto à sua delimitação conceitual e a multiplicidade de tipologias e modelos analíticos. Observa-se que os SOC apresentam dimensões estruturais, funcionais e contextuais que ampliam sua compreensão como instrumentos de organização e recuperação da informação. Verifica-se, ainda, que esses sistemas não seguem uma lógica evolutiva linear, mas um movimento de continuidade, reconfiguração e integração, especialmente em contextos digitais e interoperáveis. Conclui-se que a

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análise dos SOC demanda abordagens que considerem sua natureza multidimensional, sociotécnica e contextualmente situada.

Palavras-chave: Sistemas de Organização do Conhecimento; Organização do Conhecimento; Tipologias; Modelos analíticos.

Sistemas de Organización del Conocimiento: definiciones, tipologías, características e instrumentos — mapeo y análisis de la literatura

Resumen:
Este estudio tiene como objetivo analizar las definiciones del término Sistemas de Organización del Conocimiento (SOC) en la literatura, así como sus tipologías, modelos analíticos y características en el contexto contemporáneo. Se adoptó como procedimiento metodológico la Revisión Sistemática de la Literatura (RSL), a partir de la cual se constituyó un corpus de siete estudios alineados con los objetivos de la investigación. Los resultados evidencian la diversidad terminológica asociada al término SOC, la ausencia de consenso respecto de su delimitación conceptual y la multiplicidad de tipologías y modelos analíticos. Se observa que los SOC presentan dimensiones estructurales, funcionales y contextuales que amplían su comprensión como instrumentos de organización y recuperación de la información. Asimismo, se verifica que estos sistemas no siguen una lógica evolutiva lineal, sino un movimiento de continuidad, reconfiguración e integración, especialmente en contextos digitales e interoperables. Se concluye que el análisis de los SOC requiere enfoques que consideren su naturaleza multidimensional, sociotécnica y contextualizada.

Palabras clave: Sistemas de Organización del Conocimiento; Organización del Conocimiento; Tipologías; modelos analíticos.

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1 Introduction

This article is situated within the field of Knowledge Organization (KO), a core subarea of Library Science and Information Science (IS). From the early definitions of Borko (1968), through the foundations presented by Le Coadic (2004), to the current conjuncture, a significant expansion of the research themes can be observed, especially as a result of the advent of the internet and of the digital transformations in society. In this context, IS has come to face new paradigms, both to be investigated and revisited from new perspectives, without, however, losing sight of its central objective of information retrieval, already outlined by Vannevar Bush in the 1940s (Araújo, 2014).

According to Hjørland (2008), KO comprises activities related to subprocesses such as the description, representation, storage and organization of documents, subjects and concepts, carried out both by humans and by computational systems. To implement these subprocesses, KO mobilizes a set of resources, including theories, methodologies, products and instruments, which enable the treatment and retrieval of information, this being its core objective.

In a scenario in which digital technologies have profoundly transformed the ways in which information is produced, organized and accessed, IS now demands new theoretical and methodological contributions, as well as the development of resources capable of meeting the new dynamics of knowledge organization. In this sense, Bräscher and Café (2008, p. 8) define KO as "the process of modeling knowledge that aims at the construction of knowledge representations", grounded in the analysis of concepts and their characteristics, with a view to defining their positions within a domain and their relations to other concepts that make up a notional system.

The scope of KO encompasses work with concepts, or units of knowledge, allowing the construction of models of the world and the establishment of relations based on "statements about the referents" (Bräscher; Café, 2008, p. 8).

Several definitions are attributed to KO as a field of study within Library Science and IS, whose nuances and terminological variations still give rise to debate, especially in a context marked by the growing interconnectivity and digitalization of information. In this sense, it is important that professionals in the field who work with knowledge representation instruments, as well as future librarians in training, understand the meaning, typology, analytical models and specific characteristics that distinguish knowledge organization schemes.

However, the rapid technological evolution and the incorporation of contributions from related fields have generated a complex terminological fluctuation in the scientific literature of the field. The coexistence of a plurality of concepts is observed, ranging from the traditional documentary languages, indexing languages and controlled vocabularies to broader or more contemporary designations, such as schemes, instruments, tools and structures for the representation of information and knowledge. Under the influence of international literature, the umbrella term Knowledge Organization Systems (KOS), translated into Portuguese as *Sistemas de Organização do Conhecimento* (SOC), has come to encompass all of these artifacts, from authority lists to complex ontologies. However, this overlap of terms frequently occurs without a clear delimitation of their theoretical boundaries and specific typologies, creating ambiguities that challenge the scientific advancement of the field and the training of professionals.

In view of this scenario, the following question was investigated in this research: How are Knowledge Organization Systems defined, typified and characterized in the scientific literature of the field?

Much like IS, KO is configured as an interdisciplinary field that seeks theoretical support in areas such as philosophy, linguistics, cognitive psychology and, more recently, computer science, in addition to library science itself. Within the latter, Smiraglia (2002, p. 331) defines KO as the area concerned with the construction of tools intended for the storage and retrieval of documentary entities. This entire theoretical framework underpins the creation of instruments for the representation of information and the organization of documentary entities. More than technical structures, such instruments function as schemes that foster semantic mediations to represent concepts and their semantic relations, revealing a notional system and the complexity of knowledge in increasingly digital informational environments. In this context, understanding how these tools have evolved and diversified is fundamental to understanding the very effectiveness of information representation today. In light of this scenario, and with the aim of conceptually delimiting these knowledge organization instruments that materialize the theory of the field, the objective of this article is to analyze the definitions of the term Knowledge Organization Systems in the scientific literature, identifying their typologies, analytical models and characteristics in the contemporary context.

2 Knowledge Organization Systems

According to Silva and Miranda (2017), the expression Knowledge Organization Systems (KOS), translated into Portuguese as *Sistemas de Organização do Conhecimento* (SOC), was coined in 1988, in the city of Pittsburgh (USA). Hodge (2000) is identified as one of the first authors to use the term in the scientific literature, highlighting the diversity of instruments that make up KOS, as well as their applications in different informational contexts.

For Hodge (2000), KOS include classification systems, subject headings and authority records, which act in the organization and control of information and are considered central elements in libraries, museums and archives. According to the author:

> Knowledge organization systems include classification schemes that organize materials at a general level (such as books on a shelf), subject headings that provide more detailed access, and authority files that control variant versions of key information (such as geographic names and personal names). They also include less-traditional schemes, such as semantic networks and ontologies. Because knowledge organization systems are mechanisms for organizing information, they are at the heart of every library, museum, and archive (Hodge, 2000, p. 11).

It is important to observe that the definition presented by Hodge (2000), although fundamental to the consolidation of the concept, is situated in the early 2000s and reflects a context still strongly tied to traditional informational objects. Such a conception predates significant transformations in the digital environment, such as those associated with the so-called Web 2.0, a term coined by Tim O'Reilly in 2004, which marks a new phase of the Web characterized by the intensification of communication, information sharing, interoperability and collaboration among users (Robredo, 2010).

In this scenario, new forms of knowledge organization and representation emerge, broadening the scope of KOS. Earlier studies, such as those by Soergel (1997) and Vickery (1997), had already pointed to the potential of ontologies as instruments for knowledge organization. Subsequently, authors such as Smith (2004) and Castilla (2007) deepen this perspective by highlighting the role of ontologies in the integration of standardized vocabularies and in the support of systems capable of dealing with complex and heterogeneous information.

Currently, ontologies are recognized as important instruments within the set of KOS, alongside other traditional systems. As pointed out by Carlan and Medeiros (2010), as early as the beginning of the 2010s, a significant growth of interest in more complex instruments, such as ontologies, was observed, which represented a significant share of the scientific output in the field.

Zeng and Chan (2004) define KOS as a general term that refers to tools designed for the organization and interpretation of knowledge structures. According to the authors, over time, different approaches and interpretations regarding the types and functions of KOS were developed, reflecting the diversity of applications of these systems.

More recent studies tend to consider KOS from the standpoint of their expanded application across different sources and informational environments, with emphasis on their role in information retrieval and in promoting interoperability in the context of the Web. In this sense, the ISO 25964-1/2 standard (2011/2012) defines KOS as vocabularies used for information retrieval across multiple media — including text, image, audio and multimedia objects — in different types of systems, such as databases, portals and digital collections (ISO, 2011).

The standards and guidelines for the construction of these instruments, such as ISO 25964, have incorporated recommendations aimed at updating knowledge representation strategies, with emphasis on interoperability among controlled vocabularies. In this context, the role of the aforementioned standard stands out in the definition of protocols and formats

for data exchange, especially in the development of multilingual controlled vocabularies and *thesauri*.

3 Methodology

To achieve the proposed objective, the methodological procedure adopted was the Systematic Literature Review (SLR), operationalized through an adaptation of the protocol proposed by Borges (2020), developed to support the conduct of systematic reviews in different areas of knowledge, and complemented by a qualitative content analysis of the selected studies. The research is characterized as qualitative and theoretical-exploratory in nature, seeking to understand how KOS are defined in the literature of the field, as well as to identify their typologies, analytical models and characteristics. The investigation was guided by the following question: How are Knowledge Organization Systems defined, typified and characterized in the scientific literature of the field?

With a view to identifying definitions, typologies, analytical models and characteristics attributed to KOS in the specialized literature, the SLR method was adopted, defined by Galvão and Ricarte (2020) as a process that comprises all published works that offer an examination of the literature covering specific subjects. The SLR was conducted in three main stages:

Stage 1 – Exploratory survey: initially, an exploratory survey was carried out in the Google Scholar database, with the aim of understanding the state of the art of the topic and identifying relevant terms, authors and sources for the construction of the search protocol.

Stage 2 – Definition of the search protocol: based on the exploratory survey, a search protocol was developed for the SLR, with data collection carried out between October and December 2021.

The following information sources were selected: LISTA; BRAPCI; Web of Science; Base de Teses e Dissertações; Proceedings of ENANCIB (GT-2) and Proceedings of ISKO. The searches were conducted in Portuguese, English and Spanish, using the terms: “sistemas de organização do conhecimento”; “knowledge organization systems” and “sistemas de organización del conocimiento”. The document types considered were: journal articles; theses; dissertations; and conference papers. The initial survey resulted in 577 publications, as shown in Table 1.

The following inclusion criteria were considered: peer-reviewed publications; direct thematic adherence to the study of KOS; credibility of the sources; and availability of access to the full text. The exclusion criteria, in turn, were: studies that address KOS peripherally;

works focused exclusively on a single instrument or specific application; and studies not aligned with the objective of the research.

Table 1- Initial results of records by database and keywords

Database	Keywords	Articles retrieved
Brapci	sistemas de organização do conhecimento	62
	knowledge organization systems	21
	sistemas de organización del conocimiento	10
LISTA	sistemas de organização do conhecimento	193
	knowledge organization systems	23
	sistemas de organización del conocimiento	23
Web of Science	sistemas de organização do conhecimento	0
	knowledge organization systems	226
	sistemas de organización del conocimiento	0
BDTD	sistemas de organização do conhecimento	18
	knowledge organization systems	1
	sistemas de organización del conocimiento	0
Total	577 publications	

Source: research data (2026).

After the application of the search protocol and the analysis of titles, keywords and abstracts, it was observed that a significant portion of the classic literature on KOS was not retrieved by the search strategies adopted. In addition, the unavailability of specialized databases in the field, such as LISA, ISTA and H. W. Wilson, constituted a limitation of the research. Because of these restrictions, a complementary stage of manual search was carried out in publications of GT2 of ANCIB, from the International Society for Knowledge Organization (ISKO), especially in works linked to ISKO Brasil. This strategy made it possible to broaden the coverage of the *corpus* and to identify relevant studies aligned with the objectives of the investigation.

After the application of the inclusion and exclusion criteria previously defined in the search protocol for the mapping of the literature, the research *corpus*, Table 2, was composed of seven articles. This number reflects both the specific delimitation of the object of study and the rigor of the criteria adopted for the mapping of the literature. However, it is acknowledged that the limitations of the retrieval strategy and the unavailability of specialized databases may have restricted the identification of other potentially relevant studies.

Table 2 - Studies analyzed and complementary theoretical references

Part A – Systematic review *corpus*		
Authors	**Year of publication**	**Article title**
Barité	2012	Sistemas de organización del conocimiento: una tipología actualizada
Carlan e Medeiros	2010	Sistemas de Organização do Conhecimento na visão da Ciência da Informação
Lara	2015	Propostas de tipologias de KOS: uma análise das referências de formas dominantes de organização do conhecimento
Ferreyra	2021	Sistemas de organización del conocimiento: propuesta de un modelo unificado de definición
Silva e Miranda	2017	Categorizações de SOC:Uma investigação literária
Souza *et al.*	2012	Towards a Taxonomy of KOS: Dimensions for Classifying Knowledge Organization Systems
Zeng	2008	Knowledge Organization Systems (KOS)
Subtotal	**7** publications	
Part B – Complementary theoretical references used in the discussion		
Authors	**Year of publication**	**Article title**
Hjørland	2015	Theories are Knowledge Organizing Systems (KOS)
Hjørland	2021	Information Retrieval and Knowledge Organization: A Perspective from the Philosophy of Science.
Mazzocchi	2018	Knowledge organization system (KOS)
Mai	2011	The modernity of knowledge organization
Subtotal	4 publications	
Total	**11 publications**	

Source: research data (2026).

Stage 3 – Selection and analysis of the studies: the final selection was made based on the analysis of the title, keywords and abstract of the publications. The studies selected for Part A - *Corpus* of the systematic review were submitted to content analysis, with the aim of identifying conceptual and structural patterns in the literature. The categories of analysis were defined *a priori*, based on the objective of the research and on the theoretical framework of the field, guiding the reading and interpretation of the selected studies. The following categories were considered:

- Terminological aspects of the term: analysis of the different denominations, conceptual variations and uses of the term Knowledge Organization Systems in the literature;
- Typologies of KOS: identification and comparison of the types of KOS presented by the authors;
- Analytical approaches and classification models of KOS: analysis of the proposals for the structural classification of KOS, based on theoretical models and schemes;
- Characteristics and dynamics of KOS in the contemporary context: identification of attributes, functions and structural and conceptual differences among the systems.

Expansion of the analytical framework: to deepen the interpretation of the results and to respond to contemporary discussions in the field, four reference works on KO and KOS were incorporated. Thus, the set analyzed came to comprise seven studies selected through the systematic review and four complementary theoretical references, totaling 11 documents considered in the discussion.

4 Results and analysis of the literature

The following topics present a theoretical synthesis of the results, elaborated from the analysis of the selected publications. The results were organized according to the four categories defined in the methodology, making it possible to analyze the term, the typologies, the analytical models and the contemporary dynamics of KOS.

4.1 Terminological aspects of the term

The literature in the field of Information and Knowledge Organization presents different attempts at categorizing and typifying KOS, evidencing significant terminological variation. Souza *et al*. (2012,p.188) refer to this phenomenon as the process of "giving typology to typology", highlighting the conceptual complexity involved in delimiting these instruments. This terminological diversity is also pointed out by Hodge (2000) and Klein and Smith (2005), who indicate that both the terminology related to terminology and the concept of concept tend to generate ambiguities, hindering the process of knowledge representation.

From the studies of Silva and Miranda (2017), Souza *et al*. (2012) and Zeng (2008), it is observed that, although there are convergences regarding the general function of KOS, there are significant variations in the way these systems are named and understood. In the context of the analyzed literature, terms such as controlled vocabularies, documentary languages, classification systems and "knowledge organization and representation" are identified, which, although related, are not necessarily equivalent.

Barité (2012) and Lara (2015) reinforce the existence of this terminological variation, indicating that different theoretical traditions and application contexts contribute to the multiplicity of denominations. In this sense, Souza *et al*. (2012), based on Wright (2005; 2008), also mention the term Knowledge Organization Schemes, emphasizing the social and practical dimension of the construction of these instruments.

Additionally, Zeng (2008) uses the expression categorization schemes to encompass instruments aimed at the classification and organization of concepts, including taxonomies and classificatory systems.

Despite this terminological diversity, literature converges in recognizing KOS as structured conceptual systems, composed of terms, definitions, relations and properties, with the purpose of promoting terminological standardization and supporting information retrieval (Carlan; Medeiros, 2010).

It is also observed that some studies tend to group, under the denomination of KOS, both traditional representation instruments, such as bibliographic classification systems and lists of subject headings, and more recent instruments, such as ontologies and concept maps (Barité, 2012; Souza *et al*., 2012). However, this broadening of scope reinforces the need for greater conceptual precision in delimiting the term.

In the normative sphere, it is observed that the ISO 25964-1 standard (2011) adopts the term "(controlled) vocabularies" as the denomination for instruments used in the organization and retrieval of information, including *thesauri* and other types of structured vocabularies. This perspective evidences a more operational and applied approach, oriented toward the construction and use of these instruments in information systems.

This terminological dispersion and the dichotomy between operational and conceptual approaches are grounded in the very definition of KOS proposed by Hjørland (2008; 2015). The author clarifies that KOS can be understood in a narrow sense, as semantic tools and selections of concepts with indications of their relations, and in a broad sense (Hjørland, 2015). Thus, the multiplicity of terms identified in the literature reflects the coexistence of these two levels of understanding: while standardization and professional practice tend to focus on the specific and instrumental dimension of KOS, contemporary theoretical research frequently expands its view to the broad and structural sense of these instruments (Hjørland, 2015). Finally, Mazzocchi (2018) reinforces that, in view of the current scenario of KO, it is especially necessary to establish an explicit connection between these two dimensions. In this sense, the broad meaning corresponds to the intellectual and social organization of knowledge itself, relating to the way in which it is structured in society and in conceptual systems. Thus, the dispersion identified in the literature reflects the coexistence and mutual dependence between these two levels: while standardization and practice apply the instrumental and strict dimension of KOS, contemporary research seeks to integrate it into this broader social and structural horizon (Hjørland, 2015; Mazzocchi, 2018).

4.2 Typologies of Knowledge Organization Systems

The classification and categorization of Knowledge Organization Systems (KOS) into typologies is not a widely consolidated effort in the literature, being a field still marked by attempts at systematization. In this context, the proposal of Hodge (2000) stands as an important reference for the organization of these instruments.

The author proposes a typology based on three major groups:

- Term lists, in which the presentation of definitions and terminological equivalences is privileged;
- Classification systems, oriented by the organization of subjects into hierarchical structures;
- Relationship-based systems, which emphasize the connections between concepts and objects in a domain of knowledge.

This typology makes it possible to understand different levels of complexity in knowledge organization, ranging from simpler structures to systems that incorporate more elaborate semantic relations.

In this sense, KOS are not limited to the functions of organizing and representing information, also playing a fundamental role in information retrieval. The literature indicates that, in their contemporary configuration, these systems come to incorporate more complex semantic relations, not only between concepts, but also between documents, users and contexts of use (Barité, 2012).

The importance of constructing typologies is highlighted by Lara (2015), who emphasizes their relevance for the theoretical development of the field, based on the analysis of the specific characteristics of each instrument. According to the author, the identification of facets, advantages, limitations and particularities of the different KOS contributes to a more refined understanding of these systems.

However, the terminological diversity present in the literature directly impacts the construction of these typologies, hindering the precise delimitation of the instruments that can be classified as KOS. This multiplicity of denominations reinforces the need for analytical approaches that consider not only the structures of the instruments, but also their contexts of use and development. In this direction, the classic typologies proposed by Hodge (2000), Barité (2012) and Lara (2015) remain relevant for the understanding of KOS, but more recent discussions, such as those of Hjørland (2021), reinforce the heterogeneous and evolving character of these systems.

4.3 Analytical approaches and classification models of KOS

Zeng (2008) proposes a taxonomy of KOS based on their structural and functional characteristics, offering an analytical model that expands previous approaches, such as Hodge's (2000).

The scheme presented by the author organizes KOS into four major sets:

a) term lists;

b) metadata-like models;

c) classification and categorization systems;

d) relational models.

This proposal can be understood as an expansion of the typology of Hodge (2000), insofar as it details the instruments not only from the standpoint of their structure, but also of the functions they perform in the processes of organization and retrieval of information. In this sense, Zeng (2008) groups KOS according to three main functions: a) elimination of ambiguity; b) control of synonyms or equivalents; and c) establishment of semantic relationships.

a) Structures aimed at the elimination of ambiguity: these structures are characterized by their simplicity of implementation, use and maintenance. Their main objective is to restrict and qualify information retrieval through additional attributes, such as language, format, time and location. This group includes instruments such as picklists, dictionaries and glossaries, which act mainly in the basic standardization of terms and in the reduction of linguistic ambiguities.

b) Structures aimed at the control of synonyms or equivalents: in this group, the instruments focus on terminological normalization, promoting the grouping of equivalent terms to avoid dispersion in information retrieval. Included here are: synonym rings; authority records (as in the MARC 21 standard); *thesauri*; subject headings; and gazetteers (geographic dictionaries).

These structures are fundamental for reducing problems such as high unqualified recall and for improving retrieval precision. Despite their apparent structural simplicity, they demand a high investment of time and effort for their construction and maintenance.

c) Structures focused on explicit semantic relationships: these structures are characterized by the explicit statement of relationships between concepts, and may involve different types of relationships, such as hierarchical (generic, instance or whole-part) and associative (based on conceptual connections or co-occurrence). This group includes taxonomies; classification systems; semantic networks; ontologies; and *thesauri*.

These instruments represent more advanced levels of knowledge organization by incorporating structured semantic relationships that allow not only organization, but also inference and conceptual navigation.

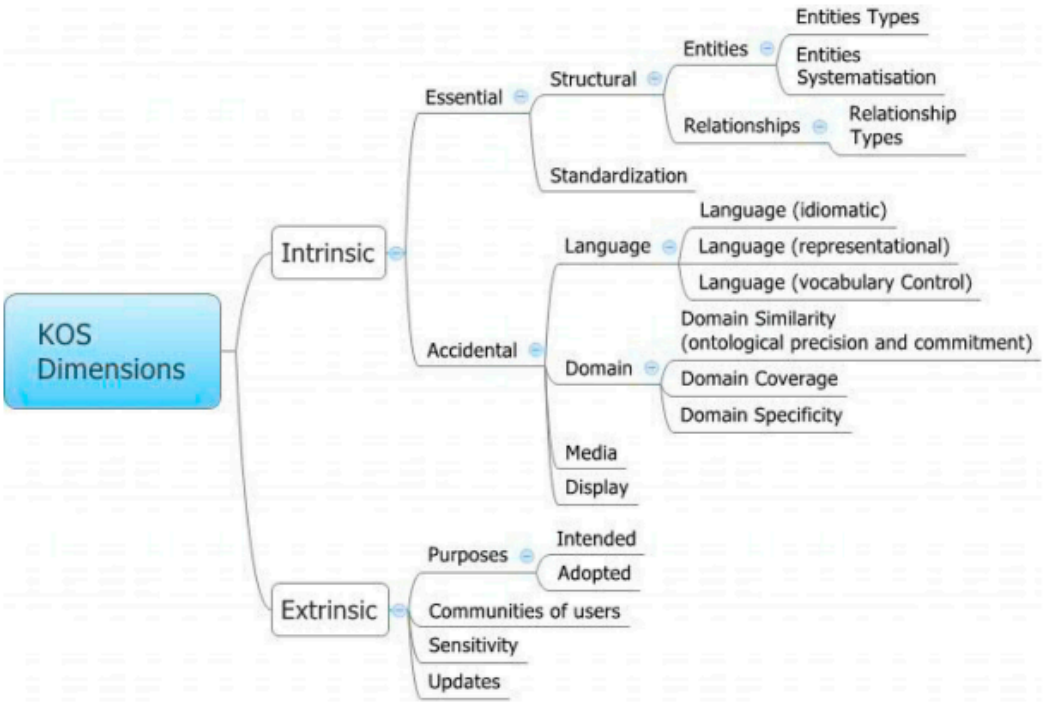
In addition to the proposal of Zeng (2008), Souza *et al*. (2012) present a complementary approach based on a dimensional taxonomy, structured around two analytical axes: intrinsic and extrinsic dimensions of KOS.

The intrinsic dimensions refer to the internal characteristics of the systems, such as structure, language, domain and types of relationships. The extrinsic dimensions, in turn, concern the context of use, including purposes, user communities and updating processes.

This perspective broadens the understanding of KOS by incorporating both structural aspects and elements related to the use and application of these systems in specific informational contexts. This approach evidences a shift in perspective, in which KOS are no longer understood merely as organizational structures and come to be analyzed as sociotechnical systems.

Figure 1, prepared by the authors, stems from the need to analyze KOS from a plural perspective. This approach is justified by the understanding that previous classifications, including the proposal of Zeng (2008), tend to present analytical limitations, especially because they adopt a linear and evolutionary view of these systems.

Figure 1 – Dimensions in knowledge organization systems



Source: Souza *et al*. (2012).

In many cases, such classifications take as their starting point the systems aimed at organizing information in physical media, considered as initial forms, and position the systems applied to digital contexts as more advanced stages or as more suitable to the contemporary scenario. This perspective may obscure the complexity and coexistence of different types of KOS, including traditional, physical and digital ones, as well as their multiple functions in different informational contexts.

In addition, the persistence of terminological dispersion in the literature is observed, as discussed previously, which directly impacts the understanding and delimitation of these instruments. This phenomenon can be illustrated by the case of taxonomies, whose definition varies significantly among authors:

> The range of interpretations for the term taxonomy, for example, varies considerably. We can see how different authors tend to think differently, asserting that taxonomies are less (Obrst, 2004; Daconta et al., 2005; Guarino, 2006; Zeng & Salaba; 2005) or more (Bergman, 2007; Smith & Welty, 2001) structured than thesauri. This illustrates the lack of agreement about what constitutes a taxonomy and the lack of terminology control in work on controlled terminologies (Souza *et al.*, 2012, p. 187).

The authors also highlight that studies comparing KOS originating from different contexts and functions, that is, which analyze them from the standpoint of their dimension of application, evidence a diversity of functionalities attributed to these systems. In this scenario, it is observed that each author tends to emphasize certain characteristics of the instruments, at times in a dissonant manner, with the aim of sustaining their argument.

It should be noted, however, that six of the eleven articles examined by Souza *et al*. (2012) focus specifically on ontologies, which limits a more comprehensive analysis of the other types of KOS. Thus, Table 3 should be understood as a synthesis of the characteristics discussed in the analyzed literature, and not as an exhaustive representation of KOS.

Table 3 – Characteristics of Knowledge Organization Systems in the analyzed literature

Almeida, Souza e Fonseca (2011)	Representational power, Semantic expressiveness, Intelligibility (for humans), Formalization (machine-oriented).
Bergman (2007)	Semantic strength, Time/Money Guarino.
Guarino (2006)	Ontological precision.
Hodge (2000)	Structure; Relations between concepts; Terminological control.
Lassila e McGuinness (2001)	Ontology level (formality of semantic relationships), logical reasoning.
Obrst (2004); Daconta *et al.* (2005)	Semantic Strength.
Smith e Welty (2001)	Complexity, Logical reasoning.
Soergel (2001a; 2001b)	Conceptual analysis; Conceptual coverage; Relations between concepts.

Tudhope (2004)	Entities (types, coordination, size and depth), Relationships (types, expressiveness and formality), Typical application to objects in the domain of interest (purpose), Relation that applies concepts to objects in the domain.
Wright (2006; 2008)	Communities of practice.
Zeng (2008)	Semantic strength; Structure; Semantic relations; Ontological level.

Source: adapted from Souza *et al*. (2012, p. 188).

The study by Souza *et al*. (2012) presents an approach that broadens the analysis of KOS by making explicit characteristics that are often neglected in models based on a linear chronological perspective. Among these aspects, elements such as domain coverage and the languages used both for human communication and for machine processing stand out.

The authors assume that KOS should be analyzed based on the articulation between intrinsic and extrinsic elements, which influence not only their structure, but also their forms of use and application. From this perspective, they propose a dimensional taxonomy composed of the following categories: Essential intrinsic elements; Accidental intrinsic elements; Extrinsic elements of purpose; User community; Constraints; and Updates, presented below.

a) Essential intrinsic elements: refer to the fundamental structural characteristics of KOS. They include standardization, more evident in digital instruments — especially with regard to the definition of entities and relationships — and formalization, characteristic of traditional instruments, such as classification systems.
b) Accidental intrinsic elements: relate to the variable characteristics of the instruments, such as language (idiom, language of representation and control); domain coverage or specificity; format (digital or physical); and form of presentation (symbolic, textual or systematic).
c) Extrinsic elements of purpose: concern the context of use of KOS, considering their purposes, such as terminological control, indexing or information retrieval.
d) User community: refers to the target audience for which the instrument is developed, directly influencing its structure, language and level of complexity.
e) Constraints: relate to the conditions of access to and use of the instruments, such as public or private availability and different levels of control or classification.
f) Updates: correspond to the frequency and mechanisms of updating of KOS, including who can carry them out and under what conditions.

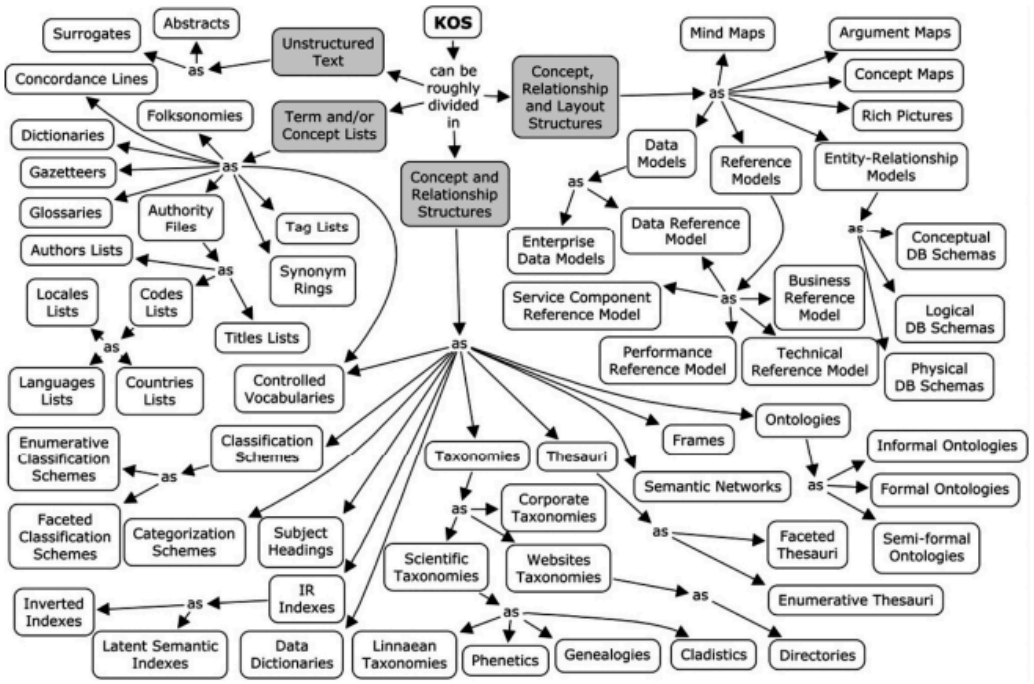
Based on these variables, Souza *et al*. (2012) identify different types of KOS, expanding the proposal of Hodge (2000). As shown in Figure 2, the instruments are grouped into:

a) unstructured texts;
b) lists of concepts or terms;
c) concepts with structural relationships;
d) concepts with formally defined relationships and structures.

It is observed that the authors include, in this classification, some instruments that are infrequent in the literature, such as abstracts and indicators, evidencing a broadening of the traditional scope of KOS.

From an analytical standpoint, this approach makes it possible to understand that KOS cannot be defined solely by their structure, but must be analyzed based on the combination of different dimensions. Aspects considered essential, such as standardization and formalization, approximate the traditional KOS described by Zeng (2008), such as bibliographic classification systems.

Figure 2 – Types of knowledge organization systems



Source: Souza *et al*. (2012, p. 181).

On the other hand, instruments aimed at digital environments, such as ontologies, are characterized by higher levels of formalization, allowing automatic inference by computational systems. The elements considered accidental, such as language, domain and format, directly influence aspects such as the need for updating and the definition of the user community.

This perspective contributes to a more comprehensive understanding of KOS by simultaneously considering their structural and contextual dimensions, although it still presents a level of generalization that may limit the more precise distinction between different types of instruments.

Finally, the study by Silva and Miranda (2017) approaches KOS from the analysis of the bibliographic production on the topic, identifying the different types of KOS present in the literature, as systematized in Figure 3.

From the selection of the analyzed studies, it is observed that the path adopted by part of the literature assumes an evolutionary and linear character, as already pointed out by Souza *et al*. (2012), in which the different types of KOS are described and organized based on their operating characteristics. This movement results, to a certain extent, in the construction of a conceptual repertoire that approaches a "glossary" of these instruments.

Figure 3 – Types of KOS and their approaches in the literature

TYPES OF KOS (approaches)	**AUTHORS**						
	Souza (2012)	Ranganathan (1967)	Souza (2007)	Broughton *et al.* (2005) and Hjørland (2008)	Hodge (2000)	Vickery (2008)	Miranda (2005)
Pre-coordinated	X	X	X	X	X	X	X
Term lists					X		X
Classifications and categories	X		X	X	X	X	X
Enumerative	X	X	X	X	X	X	X
Semi-enumerative		X	X	X	X	X	X
Faceted	X	X	X	X	X	X	X
Post-coordinated				X	X	X	X
Internet era				X	X	X	X
Relationship lists				X	X	X	X
Semantic *web* era				X	X	X	X
Other approaches				X	X	X	
Domain analysis				X			
Bibliometrics				X			
Information retrieval				X			
User orientation				X			

Source: Silva and Miranda (2017, p. 963).

In this context, a set of 15 terms recurrent in the literature that express approaches and characteristics associated with KOS was identified: (1) pre-coordinated; (2) term lists; (3) classifications and categories; (4) enumerative; (5) semi-enumerative; (6) faceted; (7) post-coordinated; (8) Internet era; (9) relationship lists; (10) Semantic Web era; (11) other approaches; (12) domain analysis; (13) bibliometrics; (14) information retrieval; and (15) user orientation.

Among these characteristics, pre-coordination stands out initially, which consists of the prior combination of terms to represent compound subjects, being traditionally associated

with analog informational environments. In contrast, post-coordinated systems are based on the combination of terms at the moment of search, allowing greater flexibility in information retrieval. This group includes instruments such as *thesauri*, taxonomies and faceted systems, applicable to both traditional and digital contexts.

Faceted classification, in particular, represents a point of intersection between traditional and contemporary models by making it possible to combine multiple aspects of the same informational object, favoring more dynamic search strategies and multidimensional navigation.

The expressions “Internet era” and “Semantic Web era” indicate a shift from the structural focus to broader contexts of application of KOS, in which the relationships between terms come to be made explicit and formalized for machine interpretation. In this scenario, the construction of explicit semantic relationships, whether by prior definition or by inference, becomes a central element for the functioning of these systems in digital environments. Unlike approaches that seek to critically analyze these transformations, the study by Silva and Miranda (2017) presents a predominantly descriptive synthesis, organizing the contributions of different authors in a linear and chronological manner. From this perspective, the authors associate pre-coordinated systems with the more traditional models, linked to bibliographic organization, while highlighting ontologies as representative of the more contemporary KOS.

Furthermore, they identify faceted classification as an element of transition between traditional and modern models by making multiple search strategies and multidimensional navigation possible, characteristics frequently associated with digital informational environments.

The different analytical models identified in the literature evidence that KOS can be understood from multiple structural, functional and contextual perspectives. This diversity can also be interpreted in light of the understanding of Hjørland (2021), for whom knowledge organization is related to the ways in which different domains structure and represent knowledge, reflecting epistemological positions and specific purposes.

4.4 Characteristics and dynamics of KOS in the contemporary context

The analysis of the literature made it possible to identify structural, functional and contextual characteristics of KOS, as well as relevant distinctions among these systems in the contemporary context. In this sense, it is observed that the understanding of KOS cannot be reduced merely to their typologies, requiring the consideration of multiple dimensions that involve their structure, uses and contexts of application.

Recent literature in the field has recognized ISO 25964 as one of the main references for the definition, structuring and use of KOS. This perspective is present in the studies of Souza *et al*. (2012) and also in more recent works, such as Rio-Branco *et al*. (2021), which specifically address questions of interoperability among these systems. In this context, the capacity for integration among different vocabularies stands out as a central characteristic of contemporary KOS, reinforcing the notion that these systems do not operate in isolation, but in articulated semantic networks.

Among the characteristics identified in the literature, the recurrence of a linear evolutionary approach stands out, in which KOS are frequently presented as the result of a progressive process that starts from simpler structures until reaching more complex and formalized models. This perspective is evidenced in the chronological organization of the analyzed studies, in which authors such as Zeng (2008) are taken up by Souza *et al*. (2012), and both underpin later studies, such as Silva and Miranda's (2017), configuring a cumulative theoretical chain.

However, this linear approach proves limited for explaining the complexity of KOS in contemporary times. Although it is possible to identify a historical trajectory that starts from the human capacity to classify, passing through the philosophical foundations of classification, as in Aristotle (Lara, 2015), through bibliographic organization and the expansion of informational production with the invention of the printing press, such a narrative is not sufficient to understand the current modes of functioning of these systems.

One of the fundamental distinctions evidenced in the literature refers to the difference between pre-coordinated and post-coordinated systems. The former are characterized by the prior combination of terms to represent compound subjects, being traditionally associated with analog contexts. Post-coordinated systems, in turn, are based on the combination of terms at the moment of search, allowing greater flexibility in information retrieval. This group includes instruments such as *thesauri*, taxonomies and faceted systems, which can be applied in both traditional and digital environments.

Faceted classification, in particular, stands out as an element of transition between different models of knowledge organization by making it possible to combine multiple aspects of the same informational object. This characteristic favors more dynamic search strategies and multidimensional navigation, bringing traditional structures closer to contemporary demands of information retrieval.

Moreover, an expansion of the functions of KOS is observed, which come to incorporate more complex semantic relations, not only between concepts, but also involving

documents, users and contexts of use (Barité, 2012). This characteristic evidences the transition from systems centered exclusively on the organization of information to systems that act more broadly in the processes of mediation and retrieval of information.

The incorporation of digital technologies intensifies this transformation. As pointed out by Zeng and Mayr (2018), KOS come to be understood not only as sets of terms used for the description of metadata, but as structures that function as semantic maps, capable of guiding both indexers and users — human or machine —, in the navigation and interpretation of information. In this sense, their capacity for formalization and for supporting computational inference stands out as a characteristic of contemporary KOS.

Another relevant distinction refers to the consideration of KOS as sociotechnical systems. Drawing on the proposal of Souza *et al*. (2012), it is observed that these systems should be analyzed based on the articulation between intrinsic elements — such as structure, language and domain — and extrinsic elements — such as purpose, user community, constraints and updating processes. This approach evidences that KOS are not merely technical structures, but instruments conditioned by institutional, social, cultural and informational contexts.

In this sense, characteristics such as domain coverage, choice of language (both from the standpoint of idiom and of the language of representation), form of presentation, frequency of updating and definition of the user community directly influence the way in which KOS are constructed, used and interpreted. These aspects reveal that the differences among KOS are not restricted to their structure, but also involve their contexts of application and their purposes.

In light of this scenario, the evolution of KOS should not be understood as a linear process of replacing traditional models with more recent digital structures. On the contrary, a movement of continuity, reconfiguration and integration among different types of KOS is observed, which come to coexist and to articulate with one another in response to the demands of contemporary informational environments. This understanding is aligned with the Mai's (2011) view and with the provisions of the ISO 25964 guidelines, as pointed out below.

Reflections by Mai (2011) indicate that KO should be understood as a dynamic practice, continuously reconfigured in response to the social, cultural and technological transformations that permeate the processes of production and organization of knowledge.

There is an alignment with the ISO 25964 guidelines, since it is perceived that they emphasize not replacement, but interoperability among controlled vocabularies. Thus, traditional instruments, such as *thesauri* and classification systems, are not superseded, but

adapted and integrated into new technological contexts, and may be formalized for use in digital environments and in applications that demand structured semantic representation.

However, it is important to highlight that, in the context of application, especially in institutional realities such as the Brazilian one, the adoption of more formalized and interoperable models may be limited by factors such as cost, infrastructure and technical training. Thus, many traditional KOS remain in use, evidencing that the coexistence among different models is not merely a theoretical characteristic, but a practical and contextual condition of KOS.

Finally, although the linear evolutionary perspective presents limitations as an explanatory model of the complexity of KOS, it has relevance from the pedagogical standpoint. This approach favors the initial understanding of the transformations in the field by organizing the different types of systems in an intelligible sequence for didactic purposes.

The results of this study indicate, therefore, that contemporary KOS are characterized by the coexistence of different models, by the integration among structures and by adaptation to multiple contexts of use. This dynamic reinforces the need for analytical approaches that overcome linear interpretations and consider KOS as heterogeneous, interdependent and contextually situated structures.

5 Concluding remarks

The present study aimed to analyze the definitions of the term Knowledge Organization Systems (KOS) in the scientific literature, identifying their typologies, analytical models and characteristics in the contemporary context.

With regard to terminological aspects, the coexistence of different definitions and uses of the term KOS was identified, reflecting both the historical evolution of the field and the distinct theoretical perspectives adopted by the authors. In this context, it is noteworthy that normative initiatives such as ISO 25964-1 (2011), by emphasizing interoperability among controlled vocabularies, represent an important advance toward the integration of KOS in digital informational environments, contributing to their articulation in increasingly complex and distributed contexts.

Regarding typologies, it was found that, although there are relevant proposals, such as Hodge's (2000), there is still no consolidated systematization that comprehensively addresses the diversity of these instruments.

In the scope of analytical approaches, models such as those of Zeng (2008) and Souza *et al*. (2012) stand out, which broaden the understanding of KOS by incorporating structural,

functional and contextual dimensions. These models evidence that KOS should be analyzed beyond their structure, also considering their uses, purposes and contexts of application.

In terms of the characteristics and dynamics of KOS in the contemporary context, the results indicate that these systems do not follow a linear evolutionary logic of replacement, but rather a movement of continuity, reconfiguration and integration. The coexistence of different types of KOS is observed, as well as their adaptation to digital environments and to demands for interoperability, as highlighted by ISO 25964-1 (ISO, 2011).

It is also noteworthy that, although the linear evolutionary perspective presents limitations as an explanatory model, it can play a relevant role in the pedagogical context by favoring the initial understanding of the different types of KOS. On the other hand, the analysis evidences the need for more critical and integrative approaches, capable of addressing the complexity of these systems.

As limitations of the study, the restricted access to specialized databases stands out, as well as the delimitation of the final *corpus* to seven articles, which reflects both the rigor of the criteria adopted and the specificity of the thematic scope. Moreover, the absence of retrieval of texts considered classics through the search strategies evidences methodological challenges in conducting systematic reviews in the field.

As future developments, it is suggested to expand the *corpus* of analysis, to include different databases and to carry out empirical investigation of the application of KOS in specific contexts, such as libraries, archives and museums, as well as in digital environments and systems based on Artificial Intelligence.

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