Knowledge Organization System and Post-Disciplinarity: Climate Change and COVID-19 in the context of the 2030 Agenda

Sistema de Organização do Conhecimento e Pós-disciplinaridade: Mudanças Climáticas e COVID-19 no contexto da Agenda 2030

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Abstract

The study was inspired by the theoretical approaches of Beghtol, Buckland, Kleinberg, and Hjørland to discuss knowledge representation on Climate Change and COVID-19 in the context of Agenda 2030. This exploratory research was based on bibliometric methods through VOSviewer and CitNetexplorer tools to analyze the terms Climate Change and COVID-19, in the databases Scopus, Web of Science, and Dimensions, in the period 2019-2020. Approaches 7 and 8 of domain analysis were used to discuss the knowledge of disciplinarity and to identify the emergence of domains. Data collected from Brazil National Council for Scientific and Technological Development, in the Lattes Platform and Directory of Research Groups, were added for analysis purposes. The conclusion pointed out that Climate Change and COVID-19 can be considered emerging domains, suggesting a possible post-disciplinary model. The 2030 Agenda reinforces the importance of international cooperation and a commitment to exchange information on scientific communities and other communities that discuss sustainable solutions to global problems such as Climate Change and COVID-19.

Keywords: Climate Change. COVID-19. Domain Analysis. Post-disciplinarity. Agenda 2030.

Resumo

O estudo foi inspirado nas abordagens teóricas de Beghtol, Buckland, Kleinberg e Hjørland para discutir a representação do conhecimento sobre Mudanças Climáticas e COVID-19 no contexto da Agenda 2030. Esta pesquisa exploratória foi baseada em métodos bibliométricos por meio das ferramentas VOSviewer e CitNetexplorer para analisar os termos Climate Change e COVID-19, nas bases de dados Scopus, Web of Science e Dimensions, no período 2019-2020. As abordagens 7 e 8 da análise de domínios foram utilizadas para discutir o conhecimento da disciplinaridade e identificar a emergência de domínios. Dados coletados do Conselho Nacional de Desenvolvimento Científico e Tecnológico do Brasil, na Plataforma Lattes e Diretório de Grupos de Pesquisa, foram adicionados para fins de análise. A conclusão apontou que Mudanças Climáticas e COVID-19 podem ser considerados domínios emergentes, sugerindo um possível modelo pós-disciplinar. A Agenda 2030 reforça a importância da cooperação internacional e o compromisso de trocar informações sobre comunidades científicas e outras comunidades que discutem soluções sustentáveis para problemas globais como Mudanças Climáticas e COVID-19.

Palavras-chave: *Mudança Climática. COVID-19. Análise de Domínio. Pós-disciplinaridade. Agenda 2030.*

1. Introduction

In the view of global sustainability, Agenda 2030 is made up of 193 signatory countries of the declaration for the accomplishment of 17 Sustainable Development Goals (SDG) comprising about 169 measures and 231 macroeconomic and social indicators. Three SDG of Agenda proposals demonstrate the scope of Climate Change as well as reinforce the importance of sustainable actions among governments, researchers, and the general public.

In face of the global risks, it is worth mentioning that SDG 13 "Take urgent action to combat climate change and its impacts", SDG 14 "Conserve and sustainably use the oceans, seas, and marine resources for sustainable development", and SDG 15 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."

Regarding Climate Change effects and the global health emergency caused by COVID-19, information research systems face a double challenge of variability data and crossing data from different sources to represent the complexity of climate phenomena and their effects on society from regional to global levels. Besides, those challenges may also indicate a shift towards post-disciplinary knowledge production in terms of the convergence of knowledge of disciplines from areas such as Human, Social, and Health Sciences, merging closer to Environmental Sciences.

The convergence of ecology, climatology, and sustainable sciences suggests the need for studies on technical aspects of cross-data assessment and data analysis from different sources. The 17 SDGs bring out the need for the construction of sustainable knowledge systems that demand a complex sociotechnical architecture for the communication of scientific information. This architecture would support the collaboration of different epistemic communities. Contemporary sciences are immersed in a global information framework that goes beyond the epistemic limits of different disciplines in the direction of the open horizon of relational knowledge. It implies that the more we exchange data.

The Intergovernmental Panel on Climate Change (IPCC) is an example of a collaborative research project, and the results are available in interactive maps that facilitate the public understanding of the increasing risk of disasters caused by Climate Change on its economic, social, and environmental impacts. IPCC Annual Reports demonstrate the importance of the researcher's collaboration from several countries through research data platforms that would benefit the modeling of climate behavior, temperature range, oceanographic activities, and other phenomena.

Despite the evidence about Climate Change effects, Giddens (2008) identified that the debate on Climate Change was segmented by specialized sectors and without a defined plan of governance. The author raised the importance of integration between government, research entities, and industry through a public platform to discuss political and economic aspects of the relation between industry and the environment.

In the context of Agenda 2030, Climate Change and COVID-19 demonstrate the emergence of a complex phenomenon that pervades social, economic, and cultural impacts that suggest new arrangements of knowledge organization and representation of information.
These contemporary themes motivated us to reflect on how scientific knowledge is connected in a

global information framework going beyond the epistemic limits of different disciplines and in the direction of the open horizon of relational knowledge.

In this perspective, the present work aims to analyze knowledge representation issues in the information retrieval process of Climate Change and COVID-19 from a sample of bibliographic data collected in three databases namely, Scopus, Web of Science, and Dimensions.

This paper is an exploratory study on post-disciplinary knowledge organization inspired by theoretical approaches and contributions to classification systems (BEGHTOL, 1998); the concept of digital object (BUCKLAND, 2012); and integrative levels and complexity of knowledge (KLEINBERG, 2017).

2. Theoretical contribution of this investigation

Scientific knowledge organized by disciplines is discussed by Beghtol (1998) who distinguishes Bibliographic Classification Systems (BCS) from Special Classification Systems (SCS). Beghtol argues that:

> […] the intellectual province of general bibliographic classification systems is the whole universe of knowledge, and this domain has habitually been analyzed into classes and subclasses on the basis of the academic disciplines. […] The first problem that arises is that disciplines are not mutually exclusive. For example, human beings may be studied from different perspectives (e.g., biological, chemical, psychological, spiritual) and each of these disciplinary standpoints overlaps the others. If we group the disciplines into the three commonly acknowledged disciplinary areas of science, social science, and the humanities, the same predicament of non-mutual exclusivity may be discerned (BEGHTOL, 1998, p. 2).

The author concludes that:

> […] the next century of classification theory, practice, and research will need to react rapidly to multidisciplinary literary warrant and to build responsiveness to different discourse communities into the concept of consensus. In order to promote intellectual exchange, research, and education that, in the electronic environment, are not limited by time, place, or a static discourse community, basic research is needed on structural principles and creative design criteria for classification systems (BEGHTOL, 1998, p.9).

Beghtol (1998) considers that classification systems should be in accordance with different discourse communities. In this sense, the present problems, and disputes regarding the impact of Climate Change and COVID-19 would be classified and indexed in almost all areas of knowledge and disciplines, which points out the modern structure of knowledge.

From a semantic point of view, Hjorland indicates that when documents are merged into large databases, implicit information from previous contexts is lost:

> The greater the degree of merging, the greater the loss of implicit information. Systems of Knowledge Organization Systems (KOS) must be developed to deal with this loss of implicit information by making it explicit through the semantics of databases (HJORLAND, 2002, p.445).

In view of domain analysis, Hjorland (2002) suggests that semantic distances among terms, genres of documents, and epistemic communities contribute to improving information systems

integration. Graminius (2020) alerts that information systems and scientific communication are difficult to access for the average public, which implies not understanding the phenomena of Climate Change and COVID-19.

Fuentes et al. (2020) consider Climate Change and the COVID-19 as global emergencies that involve transnational agencies in terms of the application of resources, the need for incentives for research projects and international cooperation, as well as the exchange of data and information. However, in terms of governance policies, the authors emphasize that decision-making agents have different risk perceptions about those phenomena, this situation brings more difficulties to find solutions.

Funtowicz and Ravetz (1994) propose a post-normal science organization. Considering the social and cultural aspects of Climate Change, Hulme (2009) criticizes the disciplinary perspective of scientific knowledge separated by areas that they don't talk to each other. In this sense, Ravetz (1995) and Hulme (2009) admit the need for a convergence of Exact and Earth Sciences with Human and Social Sciences. Hence, the complexity of Climate Change phenomena should include the perception of climate in different cultures.

The relationships between the ontologies of physical, biological, and human phenomena lead to reflection on systems theory and its importance for the organization of knowledge. In this logic, Climate Change and COVID-19 involve global cooperation that demands the implementation of the Current Research Information Systems (CRIS). In the modern Information Society Technologies world, Asserson and Jeffery (2009) explain that CRIS:

> […] provides networking anywhere with superposed services for research these services include access to research facilities, support of the research project proposal process, access to the research outputs (products, patents, publications) and support (information and processes) for the researcher, research manager, policymaker, research funder, innovator/entrepreneur and media specialist in their day-to-day work (ASSERSON, JEFFERY,2009, p.43).

One of the main aspects of CRIS is the interoperability between heterogeneous informational systems, in identifying research activities in the most varied organizations in the world.

The concept of the digital object by Buckland (2012) is a key concept in terms of the design of modern information systems, no more restricted to document retrieval process but for tackling the search to find solutions to actual problems. Boldrini et al. (2014), as an example, discuss complex information systems for modeling data about climate phenomena. The authors comment on large planet infostructure like Global Earth Observation System of Systems (GEOSS); European Infrastructure for Spatial Information in the European Community (INSPIRE); and Environment Ontology (ENVO).

These computational systems promote geoformulas that establish practices and symbolic powers in terms of climate representation synthesized under geometrics formulas (ELDEN, 2013; EDWARDS, 2010). Regarding global complex systems, Hulme (2013) criticizes the reduction of climate events considered through statistical analysis, regardless of the cultural aspects.

The information representation about Climate Change and COVID-19 suggests these terms as nomad concepts since they cross different epistemic communities, academic disciplines, and

domains of knowledge. In the holistic perspective of knowledge, Bogdan et al. (2014) give an example of the emergence of nomad concepts like Bioeconomy and Ecoeconomy, both theories contribute to the Bio-eco-geoeconomy concept.

In terms of complexity sciences, Kleinberg (2017) highlights the genetics studies that come close to the theory of integrative levels compared to the complexity of organic and inorganic systems, which was proposed in the essay by Feibleman (1954) and Foskett (1978).

The comprehensiveness of Climate Change and COVID-19 themes reinforces the importance of the theory of integrative levels to new classification systems. Gnoli (2008), Keshet (2011), and Kleinberg (2017) discuss the interaction of natural, cultural, and social phenomena in the material and mental world of human beings.

In the way of complex systems, Climate Change and COVID-19 may be compared as “the hypertext”. Therefore, terms, keywords, and concepts are “deterritorialized” or “nomads”, which are terms borrowed from the epistemological field of complexity and chaos theory, originally applied to the concept of hypertext, according to Clément (2000) who defines an open system as:

> […] a system whose existence and structure depend on an external energy (such as the flame of a candle or the eddies of a river around the wharf of a bridge). In the case of living systems, this food is not only material or energetic, but also organizational and informational (CLEMENT, 2000, p. 55).

Concerning open systems, VOSviewer as a computational tool, may deal with concepts, terms, and keywords through semantic correlations and make possible the visualization of similarities (VOS) of informational items or concepts (WALTMAN; VAN ECK, 2013), like Climate Change and COVID-19.

3. Methodology

This study is based on two approaches: a quantitative analysis through scientometrics and a qualitative approach from domain analysis. Both analyses may help to identify new domains of knowledge and possible post-disciplinary arrangements.

“Scientometrics is the measurement of scientific communication, while bibliometrics deals with more general information processes” (PATRA et al., 2006, p. 27). This method is part of the Sociology of Science and involves the study of the quantitative aspects of science as a discipline or economic activity, being used in the formulation of scientific policies. Scientometrics quantitative studies also include bibliometrics analyses (JACOBS, 2010).

From the quantitative perspective, this empirical study collected data from three international databases: Scopus, Web of Science, and Dimensions, from 2019 to 2020, in November 2020. The query search expression “Climate Change” AND “COVID-19” retrieved 378 documents from Scopus, 423 from Web of Science, and 775 from Dimensions.

VOSviewer, developed by Van Eck and Waltman, was used to analyze networks of co-occurrence of keywords from titles, abstracts, and keywords from Web of Science samples. Data mining allows the construction and visualization of bibliometric networks, based on distance, in three modalities: label (standard), density, and dispersion (VAN ECK; WALTMAN, 2010). It is worth explaining that

bibliometric networks are composed of nodes and edges. The nodes can be, for example, publications, journals, researchers, or keywords. The edges indicate the relationships between pairs of nodes, in addition to the strength of the relationship. In the network, the largest nodes show the highest occurrence of a keyword, the colors represent the clusters, and the lines indicate the relationship of the keywords (VAN ECK; WALTMAN, 2014a).

In VOSviewer, the general procedures applied were: 1) creation of a bibliometric map; 2) keyword co-occurrence analysis; 3) treatment of words through the thesaurus to deduplicate terms and lemmatization; 4) full counting process identified 3651 keywords; 5) use of 8 occurrences to generate the graph (123 keywords).

CitNetExplorer was selected to build and visualize the citation network with data from Web of Science. This tool was based on Garfield's work in algorithmic historiography and the software HistCite. Compared to it, CitNetExplorer can handle larger citation networks, including millions of publications and citation relationships (VAN ECK; WALTMAN, 2014 b).

In this experimental analysis, the core (projects, people, and organizations) of the Common European Research Information Format (CERIF) was considered as referring model to identify "author, affiliation, country, and journal title" related to the most cited authors, aligned with the two FAIR principles – Findability and Accessibility (WILKINSON et al., 2016). Figure 1 demonstrates the three main layers that compounds the diversity of agents in the production, communication, and accountability of current scientific research which represents CERIF model.

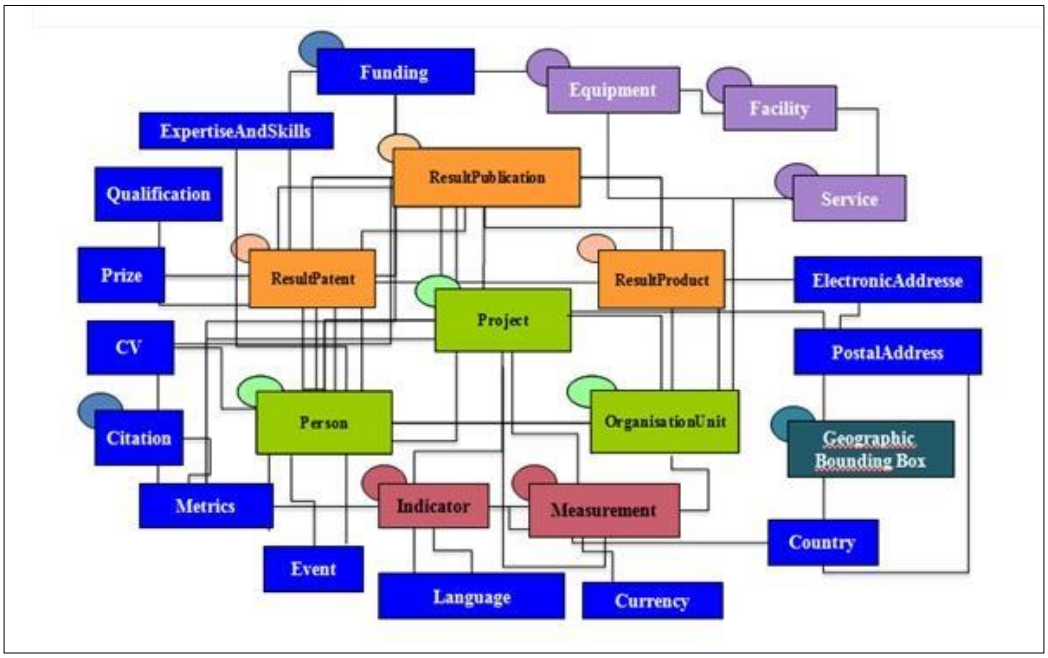

Figure 1 - CERIF

In the qualitative part, among the eleven-domain analysis suggested by Hjørland (2002), the following ones were chosen: approach 7, which encompasses the studies of documents and genres in knowledge domains, as well as approach 8, which comprises epistemological and critics of different paradigms, assumptions, and interests in domains. Furthermore, the literature review contributed and highlighted the concept of complexity and post-normal science (FUNTOWICZ;

RAVETZ, 1994) in the context of the 2030 Agenda and disciplinarity of knowledge.

The exploratory study was divided into five stages: 1) Identify and compare the most cited authors; 2) Identify and compare keywords; 3) Analyze keyword co-occurrence; 4) Analyze citation network; 3) Identify and compare subject areas; 4) Identify and compare the items “projects, people and organizations”; 5) Identify Research Groups in the database of CNPq (name, research line, and keywords); 6) Curricula search on the Lattes Platform (default search by subject); 7) Compare the results from international databases with CNPq databases.

The Lattes Platform allows managing information on the scientific and academic achievements of students, professors, researchers, and professionals involved in science and technology working in Brazil based on the so-called Lattes Curriculum (MENA-CHALCO; CESAR JUNIOR, 2009). This platform is the main scientific research information system maintained by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

4. Results and Discussion

The first step of the study was VOSviewer analysis from a sample retrieved on the Web of Science. Figure 2 represents the graph of clusters of terms and keywords in the domain “Climate Change and COVID-19”.

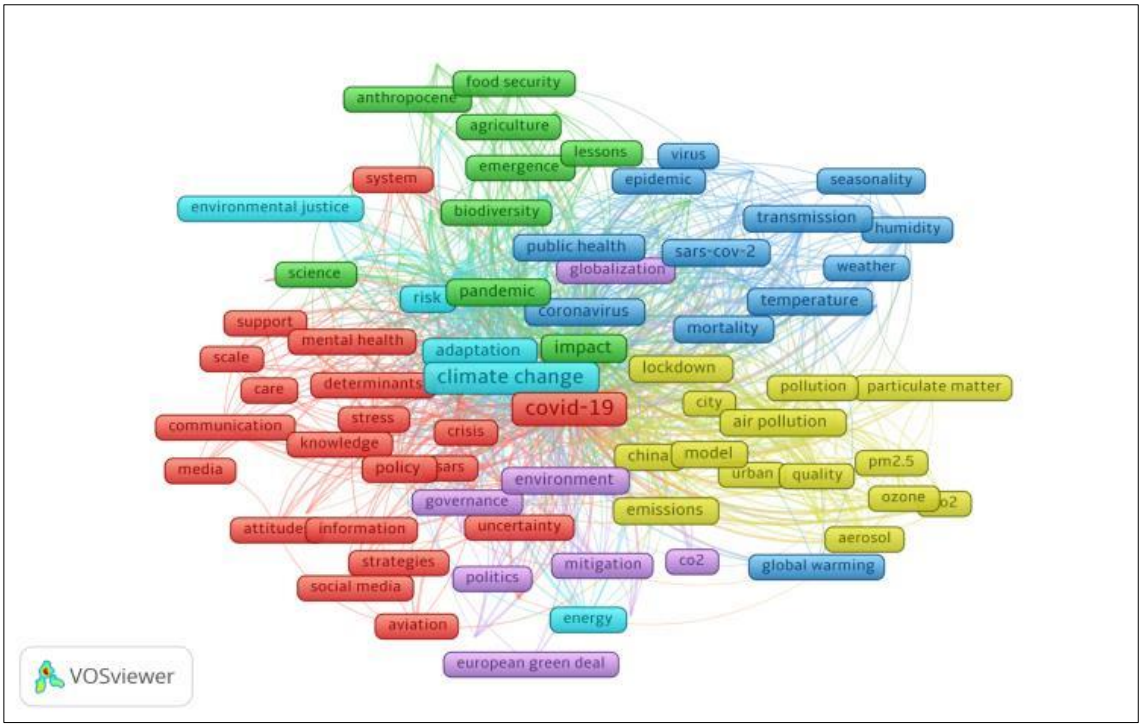

Figure 2 - Frequency Map and correlation of terms Climate Change and COVID-19 on Web of Science (2021).

The graph showed the centrality of the terms COVID-19 and Climate Change according to VOSviewer syntax. The other terms represented by different clusters signaled by labels with colors and sizes symbolize the approximation and distances between the terms, in relation to the

highlighted nucleus. It is worth noting that among the closest terms are impact, adaptation, lockdown, crisis, and stress.

In the second step, the data from the Web of Science were analyzed in the CitNetexplorer program for bibliographic coupling, as well as citation and co-citation analysis. Figure 3 demonstrates the network of authors who share the theme of Climate Change and COVID-19.

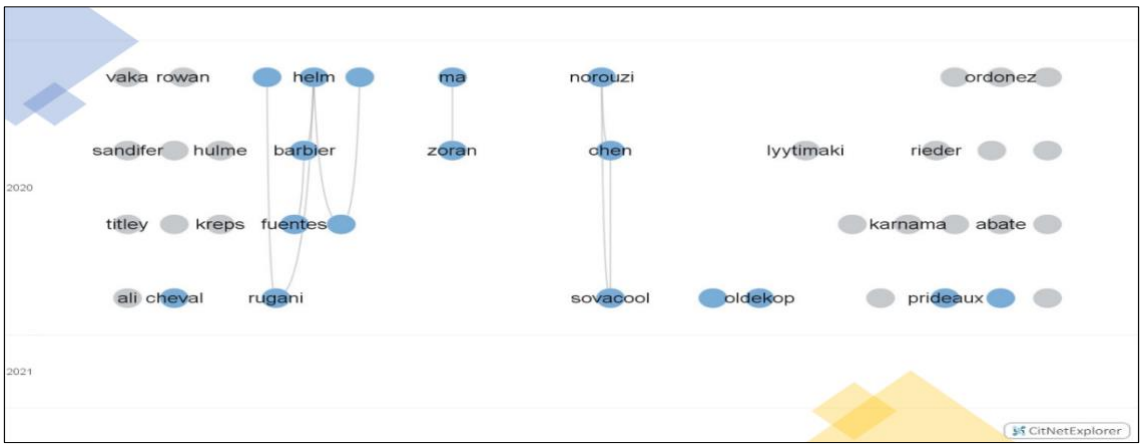

Figure 3 - Network of Climate Change and COVID-19 authors on the Web of Science (2021).

The graph in Figure 3 highlights four author groupings: 1) Helm, Barbier, Fuentes, and Rugani; 2) Ma and Zoran; 3) Norouzi, Ohen, and Savacool; 4) Cheval, Oldekop, and Prideaux.

In the third step, the data from the three international databases were processed in the VOSviewer program. A sample of the ten most-cited authors per base was analyzed to identify "people and organizations", items of the CERIF nucleus, resulting in Tables 1, 2, and 3, below.

Table 1 - Result of the analysis of the authors most cited in Scopus.

Nº.	Author	Affiliation	Country	Journal Title
1	Gossling S.	Western Norway Research Institute	Norway	Journal of Sustainable Tourism
2	Markard J.	ETH Zurich	Switzerland	Sustainability: Science, Practice, and Policy
3	Rosenbloom D.	University of Toronto	Canada	Science
4	Zarazua by Rubens G.	Aarhus University	Denmark	Energy Research and Social Science
5	Bodrud-doza, Md.	Bangladesh Rural Advancement Committee	Bangladesh	Environmental Research
6	Rahman MM	Begum Rokeya University	Bangladesh	Frontiers in Public Health
7	Shammi M.	Jahangirnagar University	Bangladesh	Frontiers in Public Health
8	Higham J.	University of Otago	New Zealand	Journal of Travel Research
9	D'adamo I.	Sapienza University of Rome	Italy	Energy Policy
10	Meo AS	Army Medical College	Pakistan	Pakistan Journal of Medical Sciences

Reference: authors creation based on data retrieved from Scopus (2021).

In Scopus, three authors from Bangladesh were identified: Bodrud-Doza, Rahman, and Shammi. Two authors also appear in the Dimensions: Bodrud- Doza, and Rahman. Zarazua de Rubens from Denmark was spotted in Scopus and Web of Science, but with different name spellings. The most cited author was Stefan Gössling from the Western Norway Research Institute. Moreover, it was noted the diversity of organizations such as committees, research institutes, colleges, and universities.

It is interesting to observe the plurality of themes in the journal titles that refer to research areas such as: tourism, sustainability, environment, public health, energy, and social sciences, which demonstrates the interdisciplinarity scope of Climate Change and COVID-19.

Table 2 - Result of the analysis of the most cited authors in the Web of Science.

Nº.	Author	Affiliation	Country	Journal Title
1	Fu, Shihua	Lanzhou University	China	Science of the Total Environment
2	Hey Xiaotao	Lanzhou University	China	Science of the Total Environment
3	Liu, Jiangtao	Lanzhou University	China	Science of the Total Environment
4	Luo, Bin	Lanzhou University	China	Science of the Total Environment
5	Niu, Jingping	Lanzhou University	China	Science of the Total Environment
6	Wang, Bo	Lanzhou University	China	Science of the Total Environment
7	Yan, Jun	Lanzhou University	China	Science of the Total Environment
8	Zhou, Ji	Shanghai Meteorological Bureau	China	Science of the Total Environment
9	De Rubens, Gerardo Zarazua	Aarhus University	Denmark	Energy Research & Social Science
10	O'callaghan, Brian	University of Oxford	United Kingdom	Environmental & Resource Economics

Reference: author's creation based on data retrieved from Web of Science (2021).

On the Web of Science, eight of the ten most-cited authors were Chinese. Lanzhou University stood out in the highest position in organizations. It is worth pointing out that one of the most cited authors is affiliated with a meteorological agency (Shanghai Meteorological Bureau).

Regarding journal titles, the centrality of the environment theme is observed in two contexts: 1) the science of the total environment; 2) the correlation of the environment with the economy as well as the social sciences. In this case, it is evident the thematic complexity of Climate Change and COVID-19.

Table 3 - Result of the analysis of the most cited authors in the Dimensions.

Nº.	Author	Affiliation	Country	Journal Title
1	Bodrud-doza, Md	Bangladesh Rural Advancement Committee (BRAC)	Bangladesh	Asian Journal of Psychiatry
2	Rahman, Md Mostafizur	Jahangirnagar University	Bangladesh	Heliyon
3	Barello, Serena	Università Cattolica del Sacro Cuore	Italy	European Journal of Epidemiology
4	Bashir, Muhammad Farhan	Central South University	China	Air Quality, Atmosphere & Health
5	Djalante, Riyanti	United Nations University-Institute for the Advances Study of Sustainability (UNU-IAS)	Japan	Progress in Disaster Science
6	Flahault, Antoine	University of Geneva	Switzerland	International Journal of Environmental Research and Public Health
7	Galea, Sandro	Harvard Global Health Institute,	United States	Disaster Medicine and Public Health Preparedness
8	Graffigna, Guendalina	Università Cattolica del Sacro Cuore	Italy	Frontiers in Psychology
9	Haines, Andy	London School of Hygiene and Tropical Medicine	United Kingdom	Cardiovascular Research
10	Lelieveld, Jose	The Cyprus Institute/ Max Planck Institute for Chemistry	Cyprus / Germany	Proceedings of the National Academy of Sciences of the United States of America

Reference: author's creation based on data retrieved from Dimensions (2021).

In Dimensions, the most cited author was Bodrud-Doza who is affiliated with the Bangladesh Rural Advancement Committee (BRAC), and who also appears in the fifth position in the Scopus ranking. Rahman is the second most cited in Dimensions and the sixth most cited in Scopus but is affiliated with different universities.

It was noted by the diversity of types of organizations, as well as locations in different countries in Europe, America, and Asia.

The interdisciplinarity of areas and fields of knowledge, such as Psychology, Psychiatry, Epidemiology, Public Health, Cardiovascular Research, Air Quality, Environmental Sciences, Atmosphere, and Health, was reflected in journal titles. The Heliyon is an example of an all-science journal.

The titles of the journals point to emerging themes, such as: Disaster Science and Disaster Medicine in Public Health, as well as Disaster Preparedness and Precaution Studies in the area of Sustainability.

In the fourth step, the most frequent terms (Table 4) and subject areas (Table 5) in each database were compared to analyze the concept of Climate Change and COVID-19 in their complexity as subjects and for representation of information.

Table 4 - Comparison of the main terms by frequency in the databases.

Nº.	SCOPUS	WEB OF SCIENCE	DIMENSIONS
1	**Climate Change**	**Covid-19**	**cov (SARS-CoV-2)**
2	**Covid-19**	**Climate Change**	Crisis
3	**Pandemic**	**Coronavirus**	Lockdown
4	Human	**Pandemic**	Patient
5	**Coronavirus disease 2019**	Policy	Transmission
6	**Coronavirus infection**	Sustainability	Challenge
7	**Coronavirus Infections**	Resilience	China
8	Viral pneumonia	Impact	March
9	Virus pneumonia	Risk	Period
10	**Betacoronavirus**	**SARS-CoV-2**	Need

Reference: authors creation based on data retrieved from databases (2021).

Regarding keywords, there were closer semantic relations of the terms retrieved in Scopus and Web of Science. In Dimensions and Web of Science, a reduced form of the term Sars-Cov-2 was noted, in the case “cov”.

In Scopus, COVID-19 is the dominant meaning with different and specific subject entries. On the Web of Science, Climate Change and COVID-19 seem to be represented in different domains related to sustainability, risk, impact, and SARS-CoV-2. In the Dimensions, we can identify different facets of Ranganathan, such as: personality (COV); matter (patient); energy (transmission, lockdown); space (China); and time (March).

Table 5 - Comparison of subject areas of the databases.

SCOPUS	WEB OF SCIENCE	DIMENSIONS
Social Sciences	**Environmental Sciences**	Studies in Human Society
Medicine	**Environmental Studies**	**Medical and Health Sciences**
Environmental Sciences	Public Environmental Occupational Health	Public Health and Health Services
Energy	Green Sustainable Science Technology	**Economics**

Business, Management and Accounting	**Economics**	**Applied Economics**
Multidisciplinary	**Multidisciplinary Sciences**	Commerce, Management, Tourism, and Services
Earth and Planetary Sciences	Meteorology Atmospheric Sciences	Political Science
Economics, Econometrics and Finance	**Medicine General Internal**	Policy and Administration
Agricultural and Biological Sciences	Geography	Sociology
Arts and Humanities	International Relations	**Environmental Sciences**

Reference: authors creation based on data retrieved from databases (2021).

The three international databases apparently represent the areas of knowledge in different ways. It is relevant to note that Environmental Sciences appear in the three databases and an area called Multimilitary in Scopus and Web of Science, which demonstrates the diversity of Climate Change and COVID- 19 as a single phenomenon.

Considering the knowledge organization of subjects on Climate Change and COVID-19, ranges from comprehensive areas (Arts and Humanities) to specific domains (Public Environmental Occupational Health and Green Sustainable Science Technology).

In the search terms, it was observed the plurality of areas that describe subjects in the databases and indications of a possible convergence of sciences focused on issues of the environment, social areas, medicine, and public health.

In the fifth step, from the CNPq database, the result of Lattes Platform retrieved: 14,448 curricula using the search term “COVID-19”; 5,064 curricula using the search expression “COVID-19 AND Environment”; 679 curricula for the search strategy “COVID-19 AND Climate Change”.

In the Directory of Research Groups for the search strategy “COVID-19 AND Climate Change” no group was found. For the search term “COVID-19”, 233 groups were found, and their research areas were identified in the following ranking: Health Sciences 44%, Biological Sciences 27.47%, Applied Social Sciences 9.01%, Human Sciences 7.73%, Exact and Earth Sciences 6.87%, Engineering 2.57%, Other 1.29%, and Literature, Linguistics and Arts 0.85%.

The search expression “COVID-19 AND Environment” identified one group, namely “Environmental Economics and Sustainable Development”, created in 1990 (last update in July 2020), in the area of Economics. The group research themes are: 1) COVID-19, Public Policies, and the Environment; 2) Green economy and payment for ecosystem services in Brazil; 3) Elaboration, analysis, and coordination of environmental public policies; 4) Financing for sustainable development; 5) Environment, international trade and input-output matrices; 6) The trade-off between income transfer policies and forest conservation.
There is a conceptual link between the group research themes with the thematic scope of the international and multidisciplinary journal “Science of the Total Environment” which covers studies on the total environment: atmosphere, lithosphere, hydrosphere, biosphere, and anthroposphere.

The present results may be lined up with the discussions in the literature about the development of complex knowledge representation systems and suggest post-disciplinary approaches to Climate Change and COVID-19.

5. Final Considerations

The new demands on social, political, and economic effects, caused by Climate Change and COVID-19, promote flexible post-disciplinary knowledge areas because the terms and concepts become nomadic. The post-disciplinary perspective was demonstrated in journal titles such as Heliyon and Science of the Total Environment. The research revealed that Climate Change and COVID- 19 are multidisciplinary domains of knowledge, which may indicate a possible change in the classic disciplinary organization of scientific knowledge. According to the journal titles, subject areas, and keywords unveiled, current scientific research is much more an example of collaborative networks, in direction of integration among disciplines and nomad concepts in interchangeable constant flow.

In this empirical study, the double structural challenge for Knowledge Organization Systems was observed: first, the plurality of knowledge domains, scientific communities, and documentary sources, point to the need for standardization that allows for efficient information retrieval procedures. Second, epistemological studies are important to construct a theory and conceptual basis to face global risks that demand immediate responses, in different contexts such as social, economic, health, infrastructure, education, and information policies

In the broad sense, the actual problem is not only how much data we can collect from different sources, but how we may organize all those data to promote mutual understanding and research cooperation in different institutions. Thus, we consider the Knowledge Organization System (KOS) as an important device to deal with terminology on unusual complex phenomena.

The diversity of terms, domains, and communities adds new difficulties in the knowledge representation and impacts semantic interoperability, especially for FAIR principles – Findability and Accessibility – in databases. In the context of the global challenges of Climate Change and COVID-19, the emergence of new knowledge domains highlights the importance of Current Research Information System (CRIS) and CERIF, as communication and information mediators between projects, people, and organizations. The two systems promote the integration of research data sources at multiple knowledge frontiers.

However, just implementing systems with digital technology infrastructure and format standards does not solve all information problems. The solution depends on international cooperation and interoperability between geolocalized communities inside or outside the academies that search for sustainable goals for emerging global problems.

The domain analysis and bibliometric tools allowed us to identify Climate Change and COVID-19 conceptual relationships among authors, networks, organizations, and documentary sources, which demonstrated transversal knowledge areas that deserve further investigation.

We believe that this work will serve as a basis for expanding social, political, and economic studies on Climate Change and COVID-19, since the proposed methodology may be applied to other SDGs of the 2030 Agenda.

The emergence of global problems stimulates the movement for a dialogical and post-disciplinary model in the search for greater symmetry among research projects, information exchange, and data governance. The debates on the 2030 Agenda and the results of the collective work of IPCC researchers already point to the way to open communities between academic and non-academic actors who share interactive knowledge ecosystems.

6. Bibliographic references

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