Annals of Library and Information Studies
Vol. 71, March 2024, pp. 92- 104
DOI: 10.56042/alis.v71i1.8992

A Domain Analysis of the Influence of *The Five Laws of Library Science*

Daniel Martínez-Ávila[a], Patrícia de Almeida[b], Bianca Savegnago de Mira[c] and Maria Cláudia Cabrini Grácio[d]

[a]Associate Professor, Área de Biblioteconomía y Documentación, Departamento de Patrimonio Artístico y Documental, Universidad de León, Campus de Vegazana, s/n 24071 León, Spain, E-mail: dmarta@unileon.es

[b]Research Professor, Programa de Pós Graduação em Ciência da Informação, Universidade Federal do Pará, Brazil / Centro de Estudos Interdisciplinares - CEIS20, Universidade de Coimbra, Portugal, E-mail: mebpatricia@gmail.com

[c]Doctoral Student, Grupo de Pesquisa Estudos Métricos em Informação, Programa de Pós-Graduação em Ciência da Informação, Universidade Estadual Paulista (UNESP), Av. Hygino Muzzi Filho, 737 - Mirante - Marília/SP - CEP 17.525-900, E-mail: bianca.mira@unesp.br

[d]Associate Professor, Grupo de Pesquisa Estudos Métricos em Informação, Programa de Pós-Graduação em Ciência da Informação, Universidade Estadual Paulista (UNESP), Av. Hygino Muzzi Filho, 737 - Mirante - Marília/SP - CEP 17.525-900, E-mail: cabrini.gracio@unesp.br

Received 05 February 2024; Accepted 20 February 2024

The Five Laws of Library Science[1] is not only regarded as one of the most relevant and influential works by Shiyali Ramamrita Ranganathan, but also as a classic of the history of Library and Information Science. This book was the result of Ranganathan's search for a philosophical foundation of the area and also was the seed of much of his later legacy, as its objectives were developed and realised in some of his other most well-known works such as the *Colon Classification*, *Classified Catalogue Code*, *Library Administration*, and *Prolegomena to Library Classification*. *The Five Laws of Library Science* is the most cited work by Ranganathan according to the Google Scholar profile created by the Indian Documentation Research and Training Centre; moreover it has been translated into several languages and it is taught in library schools around the world. In this sense, complementing previous domain analyses of Ranganathan such as Smiraglia's[2], based on the Web of Science, and inspired by the methodology of Guimarães et al.[3], who studied the influence of several works by Jesse Shera and Margaret Egan according to citations in Scopus, we conducted a search on the Web of Science Core Collection of all works citing Ranganathan. With the 306 citing documents, we conducted a domain analysis of the work mainly drawing on the bibliometric and epistemological approaches to characterise the domain of influence of *The Five Laws of Library Science*.

Keywords: SR Ranganathan, The Five Laws of Library Science, Domain analysis

1. Introduction

Classificationist, mathematician, librarian, educator, and genius, Dr. Shiyali Ramamrita Ranganathan (1892-1972) is one of the most important authors in the history of Library and Information Science worldwide. Among the vast amount of highly influential publications that were written by Ranganathan, there is one work that stands out not just for its relevance to the knowledge organisation area, but for the whole Library and Information Science field: *The Five Laws of Library Science*[1].

Although Ranganathan had formulated his Five Laws some years earlier, it was in 1931 that the first edition of the book was published. In 1957, Ranganathan published a second edition[4] that is more self-reflective and analytic. In this second edition he sought to clarify some of the ideas expressed in the book drawing on his own experience as a librarian[5]. It could be said that the Five Laws are a mirror of Ranganathan's practicality and an easy way of expressing fundamental ideas for the horizon of library work. There is a clear influence of the Indian tradition of universal postulates too. Ranganathan assumed that this work was born under the influence of the Laws of Manu, pedagogical texts that codify the Hindu philosophy of life and the organisation of society. These laws are very concise and encompass an entire philosophical ideal of library science. As for The Five Laws of Library Science by Ranganathan, they are:

1. Books are for use.

Emphasis: It is a "revolution" against the historical principle of "books are for preservation" and the financial, cultural, and managerial limitations of the institutions that held the libraries. It emphasises that

the most important aspect of having books is to facilitate their use.

2. Every reader his book.

Emphasis: It expands the idea of "books for the chosen few" to "books for all" (linked to "education for all"). Library services should focus on providing information access and education to every person, no matter their sex, class, location, condition or age.

3. Every book its reader.

Emphasis: Collection development is crucial and it must be up-to-date to meet different needs. Collection must be diversified as each book has a potential usefulness, even less popular ones. It was connected to aspects such as open access to libraries, shelf arrangement, the catalogue, publicity, and others. It is what makes the "revolution" of the First Law possible.

4. *Save the time of the reader.*

Emphasis: Time has value, so library services must be effective and useful; user access to information must be fast and easy. Open access was favoured over close stacks and classification over alphabetic arrangement. Reference work is also important. Saving the time of the staff is connected with this Law.

5. Library is a growing organism.

Emphasis: Library service has a dynamic nature, so it must innovate and evolve in accordance with new contexts. This Law addresses aspects such as growth in size, library architecture, the catalogue, the classification scheme, and staff.

The Five Laws enshrine detailed operative norms of library services and future developments[6]. Although they are expressed in few words, an example of the synthetic capacity of Ranganathan's mind, there is a deep meaning in each of them and in the set as a whole. The work analyses a wide range of challenges relating to librarians' attitudes and dynamic behaviour, staff members' responsibilities, library policies, library administration and management skills, librarians' training and technical education, moral and ethical issues, reading promotion and advocacy, reference services, user educational programmes, social literacy and education, user-centred service, collection development, book selection and documentation organisation, and many more. Ranganathan sometimes focuses on practical strategies, showing how information and knowledge must and can be accessible to all, either in the halls of academia or in a small and remote village.

The work shows and reflects the many opportunities librarians have to increase their commitment to society. The fundamental idea is that established principles lead to an established work practice that situates Librarianship among the noble professions. As Ranganathan considers information and user services as the core of librarians' work, he provides them with a philosophical foundation. In a nutshell, the Five Laws of Library Science are a guide to good practices for librarians of all times and a social awakening for the value of libraries. In this sense, the Fifth Law certainly has a special meaning for Ranganathan.

The expression "Library Science" in the title also stands out. It can also be interpreted as a statement of the scientific status of library work, an aspect that was also emerging and being established at the time (note that in 1928 the Graduate Library School at the University of Chicago was established). In fact, it was the work of authors such as Dewey, Cutter, and of course Ranganathan during those and previous years that cemented the scientific status of the area[7]. According to Loan[8], although the library profession is as old as human knowledge, library professionals worked without organised guidance until Ranganathan's laws became the pivot and bedrock for the progress and development of librarianship worldwide. These laws guided librarians in a moment in which librarianship needed scientific principles to become a Library Science. Satija[9] points out that Ranganathan "also got the subject and substance of library science recognized among the academia, intelligentsia and the government," and that institutionalisation is essential for any scientific domain.

It could be said that the Five Laws are a set of norms and precepts that enhance the profession and scientific area of Library Science and have been globally accepted as the foundation of library philosophy. The work reflects the library's ethos and all the emerging services in the information science field. This first book of Ranganathan is a classic: "This book is a sum and summary of his entire library philosophy and became the fountain head of all his later writings. His Laws are as true as laws of any social science. By induction, deduction and other methods of intellectual elaboration he carved out

canons, principles, postulates as simple corollaries of the Five Laws"[10].

The Five Laws of Library Science is not only regarded as one of the most relevant and influential works by Ranganathan, but also as one of the most significant works in the history of Library and Information Science[11]. It provided a framework for understanding the principles of effective library services and placed Ranganathan at the forefront of the Library Science field. Nevertheless, this work has sometimes been criticised for being too prescriptive and inflexible: "Some critics argue that the laws prioritize efficiency and utility over other important values, such as cultural preservation and the promotion of critical thinking. Others contend that the laws are too narrowly focused on traditional library materials, such as books, and fail to account for the diverse range of resources and formats that modern libraries offer"[12].

Time has shown that these criticisms were wrong. For instance, Connoway and Faniel[13] consider that it is possible to formulate a modern-day rephrasing, reflecting current library resources and services. Another example came two decades earlier from Crawford and Gorman[14], who were influenced and (re)interpreted the Five Laws while attempting to update them for modern society: "we have formulated Five New Laws of Library Science-based on a reinterpretation of Ranganathan's truths in the context of the library of today and its likely futures. We offer these laws in all humility, standing, as we do, on the shoulders of this giant of the library profession." Their reformulated laws are: "1. Libraries serve humanity. 2. Respect all forms by which knowledge is communicated. 3. Use technology intelligently to enhance service. 4. Protect free access to knowledge. 5. Honor the past and create the future."

Over the years, libraries have needed to adapt to different challenges and circumstances and these laws and the principles they stand for have proved applicable to several contexts (such as school libraries, see Marquardt and Bhardwaj[15], who, in their survey, find it surprising that Ranganathan's most influential book on this topic is *The Five Laws of Library Science* and not *New Education and School Library: Experience of Half a Century*; literature[16]; associations and institutions[8]; and more). Maybe that is why Fang[17] considers them a "powerful call to action for librarians". In addition, according to Dr. K.S. Raghavan[18], the Five Laws can be considered a statement of the objectives of any environment in which the tools and techniques of knowledge organisation are applied in the field, such as libraries, information centres, or information systems. Santos and Pinto[19] also observed that although these laws were formulated at a specific moment in time, it is possible to adapt them to any context of libraries or information services today. Raghavan[18] also adds, that at a more general level, they are also applicable to any system if we replace the term "book" for "commodity," "product," or "service" and replace "reader" for "customer".

In fact, these laws have inspired other scholars to present ideas as simple statements using various terms for books (documents, information, e-resources, web resources…) as a response to digital transformations and the different users' needs. This contemporary approach for emerging trends is highlighted by Fang[20], George[21], and Satija[6], all of whom recall not only the number of authors all over the world that have applied these laws to the electronic and digital environment, but also their acceptance in new domains such as artificial intelligence and expert systems (see World Wide Web[22]). Therefore, the importance of Ranganathan's book is certainly not limited to the time in which it was written, but extends to present-day information services.

The Five Laws of Library Science was the result of Ranganathan's search for a philosophical foundation for library service, something that was a common concern in the field during the last century, and also the seed of much of his later legacy, as its objectives were developed and realised in some of his other most well-known works such as the *Colon Classification*, *Classified Catalogue Code*, *Library Administration*, and *Prolegomena to Library Classification*[18]. Figuereido[23] also highlighted the importance of the Five Laws for the scientificity of the field. In fact, this book has been a seminal work for the field from the beginning and not just one of Ranganathan's "sleeping beauties"[24] that has been rediscovered in recent or later years.

Although Ranganathan is often revered for his work on facet theory and the Colon Classification in knowledge organisation circles, *The Five Laws of Library Science* seems to have made a greater impact overall, as it is the most cited work by Ranganathan according to the Google Scholar profile created by the Indian Documentation Research and Training Centre (DRTC)

(https://scholar.google.com/citations?user=T1TgnaIAAAAJ&hl=en). At the same time, it is recognized that this book has been translated into several languages and that its philosophical foundations are taught in library schools around the world. According to Marquardt and Bhardwaj[15], the reason for this is that the Five Laws can offer future librarians insights and enrich the vision of the profession when included in courses on librarianship.

Several versions of the text exist in English too and it has been reprinted many times. The second edition of *The Five Laws of Library Science* was published in 1957 and in 1963 it was reprinted with minor amendments. In subsequent years, it was translated to different languages, such as Japanese in 1981 [図書館学の五法], Chinese in 1988 [图书馆学五定律], Korean in 2005 [도서관학 5법칙], Portuguese in 2009 [As cinco leis da biblioteconomia], and Italian in 2010 [Le cinque leggi della biblioteconomia]. In fact, the Portuguese translation of the book is the fifth most cited work of the author according to the Google Scholar profile at the time of this writing.

As the influence of *The Five Laws of Library Science* goes far beyond the area of knowledge organisation, it is important to analyse the domain of that work to determine the composition of its influence on the different communities and aspects of Library and Information Science as a field. Insofar as different translations (expressions) and manifestations of the work exist unlinked on databases and their citations (considered as signalling devices[25]) are scattered, a systematic processing of the data is needed for the analysis of this influence.

2. Methodology

We conducted a domain analysis[26,27] of *The Five Laws of Library Science*, drawing on bibliometric and epistemological approaches[28,29], to characterise the domain of the influence of the work and complement previous domain analyses of Ranganathan such as Smiraglias[2]. According to Richard Smiraglia,[27,29], domain analysis as a methodology has been used by the knowledge organisation community for the discovery of ontological bases (i.e., shared core knowledge in a group) and the analysis of the evolution of scholarly communities. Birger Hjørland[30], on the other hand, holds that domain analysis as a scholarly paradigm based on an epistemology that emphasises the role of theories, perspectives, and interests has been used for the identification and classification of objects and disciplines or the construction of ontologies. Bibliometric approaches to domain analysis are widespread and established in the literature, and while they also rely on specific literature and tenets from informetrics, they still draw on the same knowledge organisation theory and authors that originated it[31]. This means that the study is not compromised by its methodology within the scope of the traditional library and information studies in which Ranganathan was situated.

As for the databases, in the introduction we noted the relevance of *The Five Laws of Library Science* according to Google Scholar. However, several studies have pointed out the relatively low quality of Google Scholar's metadata, when compared to other databases such as the Web of Science or Scopus, and the difficulties involved in extracting them as handicaps for its use in bibliometric analyses[32-37]. With this in mind, following up Smiraglia's domain analysis[2], based on the Web of Science, and inspired by the methodology of Guimarães et al.[3], that studied the influence of several works by Jesse Shera and Margaret Egan according to citations in Scopus, we traced the influence of *The Five Laws of Library Science* on the Web of Science to conduct a domain analysis of this book.

On July 13th, 2023, we conducted a search of all works citing Ranganathan in the Web of Science Core Collection ("Ranganathan SR (Cited Author)") and manually cleaned the results to select only those that cite *The Five Laws of Library Science* (merging all citations to the different editions, translations, and variations of the title) resulting on 306 citing documents. We also paid special attention to the author keywords in those citing documents as they are important, among other things, for bibliometric analyses[38]. These keywords are a reflection of the perception of the citing documents by the community that produced them and that, at the same time, considered *The Five Laws of Library Science* as a concept/cited symbol[39] whose consensus became a symbol of its meaning and importance[40].

Out of the 306 retrieved documents, 170 documents did not include author keywords and thus were discarded for the construction of that network (although they were used for the other bibliometric analyses). We processed the keywords of the

remaining 136 citing documents using the software VOSviewer[41], version 1.6.16. For the processing, we created a controlled vocabulary to correct words whose spelling was incorrect or which contained odd characters that could affect the count. Words that appeared in both singular and plural forms were also standardised, choosing the singular form. Within the software we selected the following options for the analysis: co-occurrence, author keywords, and full counting. We selected the method of full counting without weight distribution[42] on the assumption that the number and order of keywords within papers does not make a significant difference for the analysis. This process resulted in 536 keywords, but in order to highlight the most relevant keywords and generate a readable network, we established a threshold of at least two occurrences resulting in 81 keywords (15.1%). The remaining 455 keywords were considered to be unfruitful for visualisation. The analysis of these data will be presented in the following section.

As for the categorization of the document typology, there were 22 documents with two categories assigned. In such cases, we opted for selecting just one category as follows: the 18 retrieved documents labelled as "Article; Book Chapter" were included in the "Book Chapter" category; and the 4 documents retrieved as "Article; Proceedings Paper" were included in the "Proceedings Paper" category.

The data extracted from Web of Science were also used to create a co-citation network using VOS viewer. We selected co-citation as the type of analysis, cited authors as the unit of analysis, and full counting as the counting method. While the software initially identified 11,619 cited authors, we used a thesaurus to eliminate duplicates and narrowed down the number of authors to 11,564. The number of authors was still very large and prevented the program from generating a readable network (i.e., a useful visualisation for the purpose of this paper), so we decided to reduce the number of authors further using a formula based on Derek de Solla Price's Elitism Law[43]. In this sense, we calculated the square root of the 11,564 authors and rounded up to an elite of 108 authors, expanding this number to those with the same number of citations. As a result, we obtained 111 authors with a number of citations equal to or greater than 8 that we used to create the co-citation network.

3. Results and discussion

The retrieved documents date from 1957 to the present, so we can infer that the results show the enduring influence of the work *The Five Laws of Library Science*, and more specifically in the 21st century literature. Figure 1 shows the distribution of years of publication of the documents that cite the work *The Five Laws of Library Science* grouped by 5-year-periods, based on the *corpus* of 306 citing documents. It should be noted that although the book has been cited since the 1950s, the number of citations followed an increasing trend from 2005 onwards. In this sense, 77.5% of citations are from documents published after 2005, highlighting its enduring relevance and status as a classic work (as MP Satija[6] confirmed). It should also be noted that although the last period (2020-2023) presents a smaller number of citations than the previous 5-year period, this could be explained by the date in which the data were collected (July 2023) and the fact that it also comprehends 4 years (less than 3.5 years actually). On the other hand, characteristics of the citations counted by the Web of Science and the time coverage of documents indexed by the database might

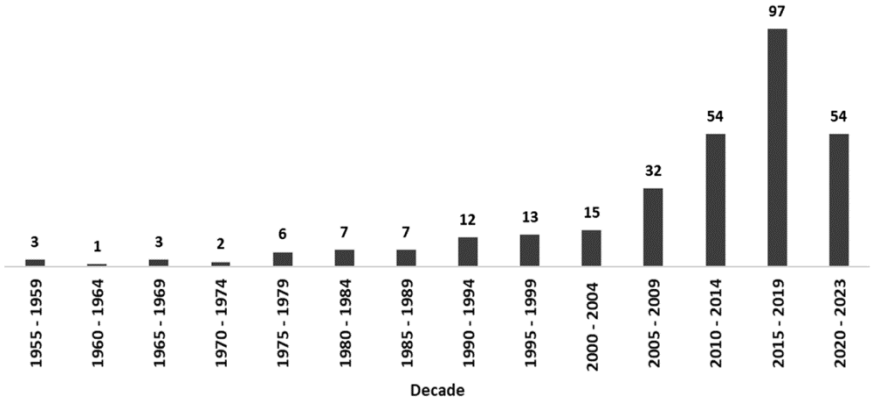

Fig. 1 — Distribution of years of publication of the 306 citing documents.

Table 1 — Distribution of the 306 citing documents by document type and language.

	Language					
Document Type	English	Portuguese	Spanish	Italian	Others*	Total
Article	180	19	2	4	1	206
Proceedings Paper	24	0	2	0	0	26
Book Chapter	18	0	0	0	0	18
Book	14	0	2	0	0	16
Review	14	2	0	0	0	16
Others**	22	0	0	0	2	24
Total	272	21	6	4	3	306

* Others = French, Turkish, Russian

** Others = Editorial Material, Book Review, Note, Letter

explain the relatively low number of citations for the period 1931-2005.

These citations, as shown in Table 1, come from a wide spectrum of document typologies (Articles, Proceedings Papers, Book Chapters, Books, Reviews, Editorial Materials, Notes, and Letters) and several languages, although predominantly from articles written in English.

If we accept that the different document typologies present different characteristics and are intended for different scholarly purposes, the results in Table 1 show that *The Five Laws of Library Science* has influenced classic scientific literature used for the study and reflections by students (such as books and manuals) as well as literature aimed at the scientific advancement of the area in the form of more immediate sources and discussions such as journal articles and conference proceedings. The age of the work has not prevented it from being cited by recent journal articles, in which discussions about new trends and philosophical foundations for LIS are published, and this confirms that the book is a strong basis for work in the area and that is a sign of its relevance and connection to the current scientific discourse.

As for the language of the citing sources, *The Five Laws of Library Science* has been cited mostly by sources written in English. This is understandable since this is the language in which Ranganathan wrote the work and the language that has become the lingua franca of (library and information) science among scholars aspiring to make their results available to a global audience. However, the fact that some sources have been published in languages other than English (19 documents in Portuguese, six documents in Spanish, and four documents in Italian, numbers that, on the other hand, are likely to be an underrepresentation of the activity in these languages given language biases in the coverage of the Web of Science Science Citation Index[44]) suggests that the work is also influential in those linguistic communities. In the case of Portuguese, Saldanha[45] states that "[f]rom the 1970s to 2022, we find an intense production on the Indian philosopher in Brazilian scientific literature in Library Science. Ranganathan's work will be received more directly because of his thought linked to classification theory. Among dozens of investigated authors, the thought of Hagar Espanha Gomes stands out from the 1970s to the present day (Gomes 1996, Campos–Gomes 2003). Hagar Gomes was responsible for developing studies of and about Ranganathan's classification theory from the Graduate Program in Information Science at the Instituto Brasileiro de Informação em Ciência e Tecnologia (IBICT), the pioneer graduate course in the "Library and Information Science" in Latin America and the Caribbean." In the case of Spanish, Rosa San Segundo introduced the work of Ranganathan in one of the very first manuals of modern knowledge organisation published in Spain[46] and even developed new terms in Spanish based on translations of the Indian author. In these and other cases, the influence goes beyond international discussions and reaches regional levels in which publishers and editors consider that there is an intellectual market and interest that justifies making the knowledge available to those researchers and professionals that cannot read the original language (and that probably generate new streams of research in their own language too).

In relation to the proceedings papers, the list below shows those conferences whose proceedings included papers citing *The Five Laws of Library Science*:

- ACM SIGIR Conference on Human Information Interaction and Retrieval (CHIIR)
- ALISE Annual Conference

- Ancient Libraries Conference
- Annual Meeting of the Medical Library Association
- Asian Conference on Intelligent Information and Database Systems (ACIIDS)
- Asia-Pacific Conference on Library and Information Education and Practice
- Congress of the Latin-American Society of Studies on Latin-America and the Caribbean
- IEEE International Professional Communication Conference
- IEEE International Symposium on Emerging Trends and Technologies in Libraries and Information Services (ETTLIS)
- Information Behaviour Conference (ISIC)
- International Conference on Active Media Technology
- International Conference on Computational Collective Intelligence
- International Conference on Computer Supported Education
- International Conference on E-Learning and Games
- International Conference on Future Computer Supported Education (FCSE)
- International Conference on Social Science and Higher Education (ICSSHE)
- International Symposium on Emerging Trends and Technologies in Libraries and Information Services
- International Workshop on Massively Multi-Agent Systems
- KES International Symposium on Agent and Multi-Agent Systems
- KES International Symposium on Intelligent Decision Technologies
- Meeting of the Association of Educators and Researchers of Librarianship Archival Science Information Science and Documentation of Latin America and the Caribbean
- Pacific Rim International Conference on Artificial Intelligence
- Pacific Rim Knowledge Acquisition Workshop
- Qualitative and Quantitative Methods in Libraries

As the title of the sources show, these scientific meetings are in the areas of Computer Science, Library Science, and Education and have an important presence in the Asian and American continents. As for the journals, we applied Bradfords' Law to the 306 citing sources to find the core journals that publish articles influenced by *The Five Laws of Library Science*. These core journals, listed in Table 2, include 14 titles that have published 105 of the 306 citing documents (34.3%). Overall, the publications belong to Web of Science categories such as Information Science Library Science, Computer Science, Information Systems or Education Educational Research. While Information Science Library Science would be the expected category of the domain, the presence of other areas such as Computer Science might have to do with the developments of the field in the digital age and Education with the philosophical importance of the book for future librarians, as it was mentioned in the introduction.

Table 2 — Core of journals that published documents that cited *The Five Laws of Library Science*

SOURCE TITLE	# Documents	%
Library Trends	15	4.9
Libri	13	4.2
Journal of Documentation	12	3.9
Journal of Academic Librarianship	10	3.3
Journal of Librarianship and Information Science	7	2.3
Library Quarterly	6	2.0
Portal-Libraries and the Academy	6	2.0
Reference & User Services Quarterly	6	2.0
Cataloging & Classification Quarterly	5	1.6
Electronic Library	5	1.6
Knowledge Organization	5	1.6
Library Hi Tech	5	1.6
Library Management	5	1.6
Revista Ibero-Americana de Ciência da Informação	5	1.6

In this list there are journals specialised in knowledge organisation, such as *Cataloging & Classification Quarterly* and *Knowledge Organization*, something that might be expected for citations of Ranganathan's work on classification, and many others with a broader scope that make up the different actors in the domain of those citing papers. The top three journals are traditional journals in the field of Library Science and Documentation. *Library Trends* could be justified as new trends use the philosophical bases of S.R. Ranganathan and this work to justify/found themselves. *The Five Laws of Library Science* is really a 'classic'. Journals focusing on academic libraries are also well represented in the list (e.g., *Journal of Academic Librarianship* and *Portal*). Other journals in the list are specialised in different tasks and services of libraries, such as reference and management. The technological side of the field is also represented in journals such as *Library Hi Tech*

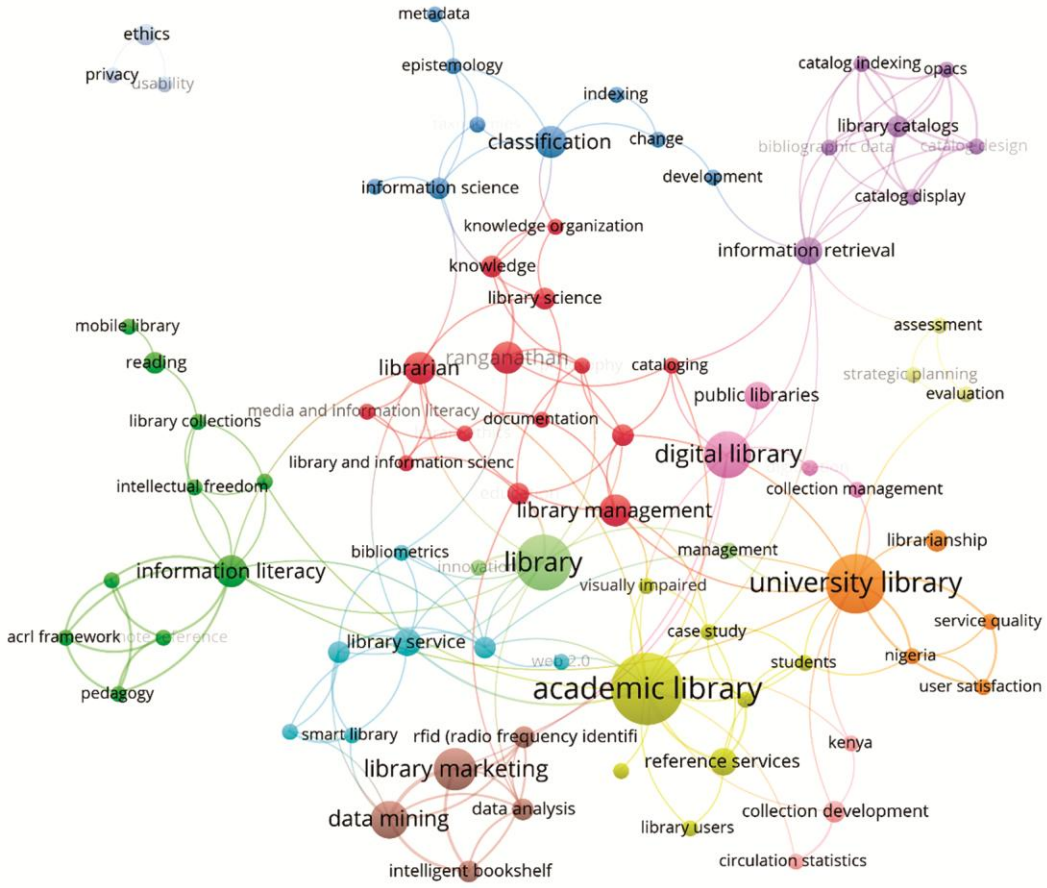

Fig. 2 — Network of co-occurrence of keywords

and *Electronic Library*. The presence of a Brazilian journal *Revista Ibero-Americana de Ciência da Informação* represents the high number of citations from Portuguese sources and also reflects the international composition of the domain, which includes an important community of researchers who have incorporated Ranganathan's work into their scholarly culture and theoretical references. While the discourse and characteristics of the journals might be defined by some editorial practices[47,48], we also acknowledge that the domain of the published corpus must be analysed with the publications themselves, i.e., the citing documents.

The co-occurrence network with the 81 selected keywords from the citing documents is shown in Figure 2. These keywords had at least two occurrences, that is, keywords with a frequency equal to or greater than (≥) 2. The network nodes are proportional to the number of occurrences, which means that, the more times the keyword was used in the documents, the bigger its node will be and vice versa. The links and groupings in the network denote the co-occurrences between the keywords. As a complement to the interpretation of the meaning of these keywords, we highlight that most of the documents (84%) have been assigned to the Information Science & Library Science WoS category, while 73% fall exclusively under this category. This means that the keywords should be read in their majority within the LIS context. The remaining documents are scattered across several categories, such as Computer Science, Information Systems, Law, and others, reflecting the complexity of the domain and perhaps the adaptation of the Five Laws to different areas and their use in transdisciplinary works.

The network has two components: one that is more interconnected with 78 keywords, occupying most of the graph, and another one with only 3 keywords (at the upper left corner). Within the larger component there are several clusters identified in different colours. Regarding the size of the nodes (frequency of the keywords), several terms stand out and are worthy of mention: "academic library" (in 14 documents), "university

library" (in 12 documents), and "library" (as a unigram, in 10 documents). Other keywords that stand out, in decreasing order of frequency, are "digital library" (in 8 documents), "library marketing" (in 7 documents), "data mining" (in 6 documents), and others with 5 occurrences each such "classification," "information literacy," "librarian," "library management," and "Ranganathan." These keywords stress the importance of the work for the library world and the connection to several areas of librarianship. Most of the clusters can be linked to the different topics addressed by *The Five Laws of Library Science*. Some of the prominent topics of these clusters, such as data mining and RFID (connected to library marketing) or digital library, correspond to new trends that have emerged long after the time of the book's initial publication.

"Academic library," in addition to being the keyword occurring with greatest frequency in the network, is also the one with the highest number of co-occurrences (ties) with other keywords (18 ties, corresponding to 9.7% of the total). The relevance of this topic can be interpreted in correspondence with Ranganathan's own life as an academic librarian and his focus on the practice of this type of library. Two of the ties of the keyword have a (co-occurrence) strength equal to 2: they are "library services" and "reference services," both of which have strong connections with the context of academic libraries. "University library," arguably a synonym of academic library although denoting perhaps a different geographical context, gathers 7.6% of the ties of the network and also presents a co-occurrence strength of 2 with three keywords: "user satisfaction", "library services," and "Nigeria," reinforcing the connection to those services offered to the public and revealing the influence of Ranganathan in the African region.

Next in line in decreasing order of number of ties, "information literacy" and "information retrieval" present 11 ties each (around 6% of the total). The keyword "information literacy" co-occurs with strength 2 with the keywords "pedagogy," "reference consultations," "remote references," and "acrl framework." Co-occurrence with these keywords reinforces the influence of the work in library services but also puts an emphasis on its educational part. Regarding the keyword "information retrieval," all co-occurrences occur only with one document (strength equal to 1) and are related to the library catalogue, knowledge organisation processes such as cataloguing and classification, digital libraries, and the like.

The co-occurrence strength between a pair of keywords corresponds to the frequency with which they are listed together in documents. In this sense, the greatest co-occurrence strength is shown between the keywords "data mining" and "library marketing", with 5 co-occurrences. As regards the presence of the term "library marketing", it should be noted that the five documents in which these keywords co-occur are listed under the WoS category Computer Science. All five documents have been authored by Toshiro Minami and one co-authored with Eunja Kim, both of whom have Japanese and South Korean affiliations; this indicates the influence of Ranganathan's work in the Asian continent. Minami is also the author of documents with 3 co-occurrences between the following keywords: "data mining" and "intelligent bookshelf" as well as "data mining" and "rfid (radio frequency identification)." These papers bring together elements of the library world that Ranganathan helped to develop and the natural technological evolution in the current millennium that reflects recent advances in Computer Science.

Finally, there are 38 co-occurrences of strength equal to 2 and 143 co-occurrences of strength equal to 1, that added to the previous co-occurrences make a total of 185. These figures show that not too many co-occurrences appear many times and the thematic representation by authors is quite diversified, as 20.5% keywords co-occur twice and 77.5% co-occur only once. In addition, most co-occurrences of keywords appear in only one document and the few strongest co-occurrences appear in documents by the same author. Regarding the topology, the network has an average degree of connectivity of 4.5, that is, on average each keyword connects to others 4.5 times. About 59.3% of the keywords are below the average degree of connectivity. At the same time, these data reveal the low connectivity of the network, the density of which is 0.057 (5.7% connected).

As for the other component of the network, the one with only three keywords ("privacy," "ethics," and "usability"), the node/keyword "privacy" presents 2 ties and 2 occurrences, the node "ethics" has 2 ties and 3 occurrences, and "usability" 2 ties and 2 occurrences. It should be noted that these three keywords co-occur in the same document, which deals with usability and privacy in academic libraries. The fact that these terms are assigned to a single document and co-occur with each other explains the formation of the subgroup, isolated from the more

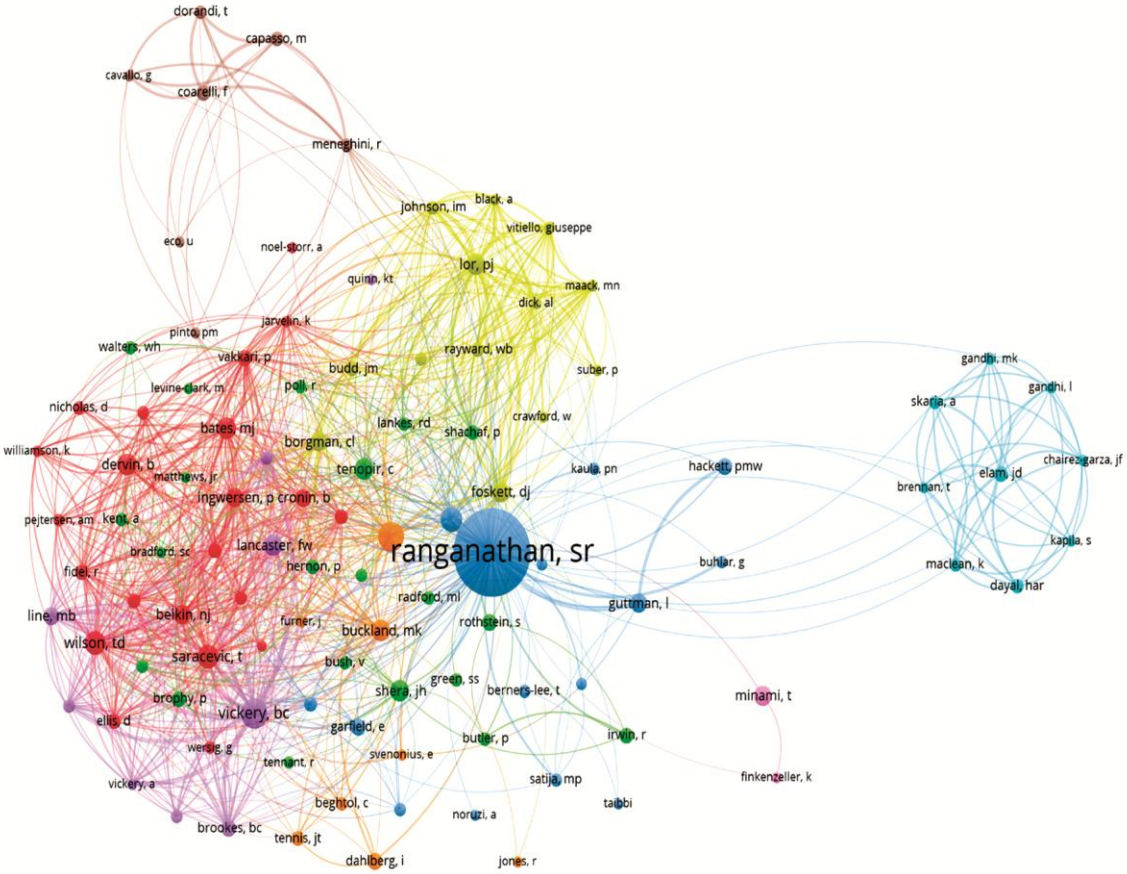

Fig. 3 — Network of author co-citation with Ranganathan's *The Five Laws of Library Science*

connected structure.

Overall, the co-occurrence network presents a low number of ties, which points to the diversity of topics addressed by the documents that cite *The Five Laws of Library Science*. However, the network and the different keywords that compose it mostly relate to the universe of librarianship, as 84% of the documents fall under the Information Science & Library Science WoS category. This means that, despite the interdisciplinary nature of the influenced domain, the work is still considered to be foundational for the developments of the area of Library and Information Science in which it appeared.

Understanding citation image as the set of authors with which an author is cited simultaneously, that is, the co-citation network in which the author is situated[49], Figure 3 presents the citation image of Ranganathan's *The Five Laws of Library Science*. This network is composed by the 111 authors from the corpus with the highest number of citations, that is, at least 8 citations each. Figure 3 also shows that the result is an ego network centred on Ranganathan.

This network presents 9 clusters of authors (each one in a different colour) that have been co-cited with Ranganathan, portrayed here by his work *The Five Laws of Library Science*. We can observe a very intense co-citation of Ranganathan with Louis Guttman (304 times). This can be explained by the fact that both authors are considered parallel founders of facet theory (Ranganathan in Library Science and Guttman in social sciences and statistics, see Beghtol's comprehensive comparison[50]). However, this is not an expected finding as *The Five Laws of Library Science* does not deal with facet theory as such. At any rate, the citations of the work in this context may well reflect the high regard in which it is held by authors who write on facet theory. The second most intense co-citation is between Ranganathan and Brian Vickery (with 130 citations together), another of the most prominent authors in facet theory –see for instance his works *Faceted Classification*[51] and *Faceted Classification Schemes*[52]– and a member of the British Classification Research Group (CRG). About the relationship between the two authors, Alan

Gilchrist[53] has commented that Ranganathan "exerted a deep and lasting influence on the CRG and many of its followers." Although Ranganathan has been linked to the empiricist view[54] that Guttman's statistics presents, much more has been written about the relationship between facet theory and its epistemological approach and this topic does not require further discussion here (see for instance Hjørland[55,56], who considers it within rationalist lines).

The red cluster is the biggest one with 22 authors, including classic names in Library and Information Science such as T.D. Wilson, Carol Kuhlthau, Tefko Saracevic, Marcia Bates, Nicholas Belkin, Brenda Dervin, Peter Ingwersen, and Blaise Cronin. Although the topics covered by all these authors have been wide and varied, we might try to see as a connection that they were all, at some point, part of the momentum gained by the newly created field of Information Science using Informatics and the latest developments in technology of the past century. During the latter part of the 20th century the field of Library and Information Science was impregnated by the "cognitive revolution" and rationalist approaches derived from computer science. The green cluster comprises 21 co-cited authors and includes, among others, Raymond Irwin, Samuel Rothstein, Jesse H. Shera, and Pierce Butler. Again, while the range of topics covered by these authors is varied, some of them can be linked to the foundations and philosophical approaches to librarianship, that is, the origins of the education in Library Science and the search for its identity in the services and practices of libraries. The blue cluster is more centrally localised in the co-citation network and is composed of 15 authors that include Louis Guttman, G. Buhlar, M.P. Satija, and Ranganathan himself, among others. In addition to the origins of facet theory with Guttman, the cluster suggests that those citations are being used in the context of Ranganathan's biography, influences (such as Buhlar's Laws of Manu), and explanations of his main achievements. As an example, P.N. Kaula was the editor of the Ranganathan festschrift and Satija has extensively written about his life and work. Eugene Garfield, one of the founders of bibliometrics, wrote a famous tribute to the late Ranganathan[57,58]. The yellow cluster has 13 authors that include D.J. Foskett, W.B. Rayward, John Budd, Archie Dick, and Peter J. Lor, among others. This is a very international group of authors who have written about classification, the lives of classificationists, comparative librarianship, the history and evolution of Library and Information Science, and its philosophical and theoretical aspects. The purple cluster comprises 9 authors, including Brian Vickery, Frederick Wilfrid Lancaster, and Robert Fairthorne. These authors work mainly with information retrieval and, as previously mentioned, facet theory in the case of Brian Vickery. The orange cluster includes 8 authors among whom we find Birger Hjørland, Elaine Svenonius, Ingetraut Dahlberg, and Michael Buckland, that is, some of the biggest names in knowledge organisation (as a field) and documentation. The cyan cluster is a peculiar one with 9 authors that include J. Daniel Elam, K. Kama Maclean, and Ajay Skaria, among others. This is the most distant cluster from the others: this means that the works that co-cite *The Five Laws of Library Science* with these authors are about topics that are thematically more distant than those in the documents of the other clusters. As for the co-cited authors, J. Daniel Elam writes about anticolonialism (and the fact that the Five Laws were developed during colonial India is mentioned by George[21]), while Kama Maclean and Ajay Skaria write about the history of India (both are cited by Elam). The point is that Ranganathan is cited as a historical figure in a book in which several authors are co-cited without being in direct relationship to Ranganathan's discourse, only because they give a description and reference to the Five Laws. While this does not mean that Ranganathan worked in the field of history, this indicates that he is part of the history of India and that the scholarly community is acknowledging that.

As for the topology of the network, it has an average degree of connectivity of 33, that is, on average each author is linked to another one 33 times. Around 49% of authors are above the average degree of connectivity and these data reveal the high degree of connectivity of the network, whose density is 0.3, i.e., 30% of the possible links between the authors who are present in the network.

Concluding remarks

Ranganathan's *The Five Laws of Library Science* became a classic shortly after its publication in the last century and, according to the results of this study, it is expected to continue being a classic in the future, as it has shown an increasing trend of citations received in the last decades. On the other hand, as it can be visualised in the networks of keywords and authors, the influence in Computer Science is not as noticeable as in Library and Information Science, as would be expected by the titles of the conferences and

journals in which the work is cited. Nevertheless, the significance of *The Five Laws to Library Science* for the technological dimension of the field cannot be overlooked either. This work shows its relevance within Library and Information Science for technological subjects such as digital libraries and related topics, as its theories continue to suit and contribute to the development of these areas. After almost a century since its publication, the nature of library work and librarians' responsibilities have become firmly situated in the digital world, and that is one of the reasons why Ranganathan's Laws are still relevant and applicable in modern libraries. In the end, this is just another recognition of the brilliance of his ideas and the justification of all the plaudits he has received over time.

Acknowledgement

We would like to thank Thomas Dousa, Carlo Bianchini, and MP Satija for their help, comments and corrections.

References

1 Ranganathan S R, The Five Laws of Library Science (Madras Library Association; Madras), 1931.

2 Smiraglia R P, Prolegomena to a New Order: A Domain-Analytical Review of The Influence of S.R. Ranganathan on Knowledge Organization, *SRELS Journal of Information Management*, 50 (6) (2013) 709-719.

3 Guimarães J A C, Gracio M C C, Martínez-Ávila D and Sales R D, The Spirit of inquiry's power to influence in 21st-century KO research: Jesse Shera and Margaret Egan, *In Challenges and Opportunities for Knowledge Organization in the Digital Age* (Nomos; Baden-Baden), 2018, p. 460-467.

4 Ranganathan S R, The Five Laws of Library Science, 2nd edn. (Madras Library Association; Madras), 1957.

5 Saldanha G, Ranganathan between philosophical and epistemological dilemmas, *Bibliothecae. it*, 12 (1) (2023) 124-153. https://doi.org/10.6092/issn.2283-9364/16781

6 Satija M P, A living library: Padma Shri S.R. Ranganathan (1892-1972), the Sole Architect of Indian Library Movement, *Bibliothecae.it*, 12 (1) (2023) 279-289. https://bibliothecae.unibo.it/article/view/16786/15880

7 Martínez-Ávila D and Guimarães J A, La Construcción de la Biblioteconomía como Ciencia y su Relación con la Clasificación, *In Organización del Conocimiento: Sistemas de Información Abiertos. Actas del XII Congreso ISKO España y II Congreso ISKO España y Portugal, 19 y 20 de Noviembre* (Murcia: Universidad de Murcia), 2015, p. 533-543.

8 Loan F A, Five Laws of Library and Information Science Associations and Institutions, *Library Philosophy and Practice (e-journal)*, 3033 (2019). https://digitalcommons.unl.edu/libphilprac/3033

9 Satija M P, A living library: Padma Shri S.R. Ranganathan (1892-1972), the Sole Architect of Indian Library Movement, *Bibliothecae.it*, 12 (1) (2023) 283.

10 Satija M P, A living library: Padma Shri S.R. Ranganathan (1892-1972), the Sole Architect of Indian Library Movement, *Bibliothecae. it*, 12 (1) (2023) 288.

11 Nalinakshi R, Relevance of Dr. S.R. Ranganathan's Five Laws of Library Science in the 21stCentury: A Clear Perspective, *Asian Journal of Information Science and Technology*, 9 (2) (2019) 111-114

12 Fang M, A Book Review of "The Five Laws of Library Science", *Information and Knowledge Management*, 4 (2) (2023) 2. https://doi.org/10.23977/infkm.2023.04020

13 Connaway L S and Ixchel M F, Reordering Ranganathan: Shifting User Behaviors, Shifting Priorities (OCLC Research; Dublin, OH), 2014. http://www.oclc.org/content/dam/research/publications/library/2014/oclcresearch-reordering-ranganathan-2014.pdf.

14 Crawford W and Gorman M, Future Libraries: Dreams, Madness, & Reality (American Library Association; Chicago and London), 1995, p. 7-8.

15 Marquardt L and Bhardwaj R K, Ranganathan's Legacy and Implications of The Five Laws of Library Science on School Librarianship: An Exploratory Study, *Bibliothecae.It*, 12(1) (2023) 154–191. https://doi.org/10.6092/issn.2283-9364/16782

16 Almeida P, The life of Ranganathan and the implications of his Five Laws of Library Science on subject indexing of fictional literature, *Informatics Studies* 6 (2) (2019) 63-70.

17 Fang M, A Book Review of "The Five Laws of Library Science", *Information and Knowledge Management*, 4 (2) (2023) 3. https://doi.org/10.23977/infkm.2023.04020

18 Raghavan K S, Shiyali Ramamrita Ranganathan, *In ISKO Encyclopedia of Knowledge Organization*, 2020. Available at https://www.isko.org/cyclo/ranganathan, section 4.

19 Santos F E P and Pinto V B, Vida e obra de Ranganathan: influências e contribuições para a Biblioteconomia, *PontodeAcesso*, 6(3): 2-19. https://periodicos.ufba.br/index.php/revistaici/article/view/6509.

20 Fang M, A Book Review of "The Five Laws of Library Science", *Information and Knowledge Management*, 4 (2) (2023) 1-5. https://doi.org/10.23977/infkm.2023.04020

21 George S, Re-looking at S. R. Ranganathan's five laws of library science, *International Journal of Librarianship*, 7 (2) (2022) 155-161. https://doi.org/10.23974/ijol.2022.vol7.2.258

22 Noruzi A, Application of Ranganathan's Laws to the Web, *Webology*, 1 (2) (2004) 1-10. https://www.webology.org/abstract.php?id=55

23 Figueiredo N M D, A modernidade das cinco leis de Ranganathan, *Ciência da Informação*, 21 (3) (1992) 186-191. https://doi.org/10.18225/ci.inf.v21i3.430

24 Bhowmick A, Santra P P and Majhi D, Sleeping Beauties in Four Epic Works on Library Science by S. R. Ranganathan: An Analytical Study, *Journal of Information and Knowledge* 60 (4) (2023) 253–260. https://doi.org/10.17821/ srels/2023/v60i4/166687.

25 Cronin B, Semiotics and evaluative bibliometrics, *Journal of Documentation* 56 (4) (2000) 440-453. http://dx.doi.org/10.1108/EUM0000000007123

26 Hjørland B and Albrechtsen H, Toward a new horizon in information science: Domain analysis, *Journal of the American Society for Information Science* 46 (6) (1995) 400-

425. https://doi.org/10.1002/(SICI)1097-4571(199507)46:6<400::AID-ASI2>3.0.CO;2-Y
27 Hjørland B, Domain Analysis, *Knowledge Organization* 44 (6) (2017) 436-464.
28 Hjørland B, Domain analysis in information science. Eleven approaches — traditional as well as innovative, *Journal of Documentation* 58 (4) (2002) 422-462. https://doi.org/10.1108/00220410210431136
29 Smiraglia R P, Domain analysis for knowledge organization: Tools for ontology extraction. (Chandos Publishing; Oxford), 2015.
30 Hjørland B, personal communication, 22nd of December, 2023.
31 Guimarães J A C, Martínez-Ávila D, Martins A and Gomes P H C, Análise de domínio em Ciência da Informação: uma análise da produção científica internacional, *Scire* 23 (2) (2017) 37-43. https://doi.org/10.54886/scire.v1i2.4445
32 Moed H F, Bar-Ilan J and Halevi G, A new methodology for comparing Google Scholar and Scopus, *Journal of Informetrics* 10 (2) (2016) 533–551. https://doi.org/10.1016/j.joi.2016.04.017.
33 Harzing A-W and Alakangas S, Google Scholar, Scopus and the Web of Science: A longitudinal and cross-disciplinary comparison, *Scientometrics* 106 (2) (2016) 787–804. https://doi.org/10.1007/s11192-015-1798-9.
34 Halevi G, Moed H and Bar-Ilan J, Suitability of Google Scholar as a source of scientific information and as a source of data for scientific evaluation—Review of the Literature, *Journal of Informetrics* 11 (3) (2017) 823–834. https://doi.org/10.1016/J.JOI.2017.06.005.
35 Delgado López-Cózar E, Orduna-Malea E and Martín-Martín A, Google Scholar as a data source for research assessment, *In Springer handbook of science and technology indicators* (Springer; Belin), 2019.
36 Martín-Martín A, Orduna-Malea E, Thelwall M and Delgado López-Cózar E, Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories, *Journal of Informetrics* 12 (4) (2018) 1160–1177. https://doi.org/10.1016/J.JOI.2018.09.002.
37 Martín-Martín A, Thelwall M, Orduna-Malea E and Delgado López-Cózar E, Google Scholar, Microsoft Academic, Scopus, Dimensions, Web of Science, and OpenCitations' COCI: a multidisciplinary comparison of coverage via citations, *Scientometrics* 126 (2000) 871–906. https://doi.org/10.1007/s11192-020-03690-4
38 Fujita M S L and Tartarotti R C D, Análise de palavras-chave da produção científica de pesquisadores: o autor como indexador, *Informação & Informação* 25 (3) (2020) 332–374. https://doi.org/10.5433/1981-8920.2020v25n3p332
39 Small H G, Cited Documents as Concept Symbols, *Social Studies of Science* 8 (3) (1978) 327-40.
40 Lardera M and Hjørland B, Keyword, *Knowledge Organization* 48 (6) (2021) 430-456. https://doi.org/10.5771/0943-7444-2021-6-430
41 Van Eck N J and Waltman L, Software survey: VOSviewer, a computer program for bibliometric mapping, *Scientometrics* 84 (2010) 523-538. https://doi.org/10.1007/s11192-009-0146-3
42 Perianes-Rodriguez A, Waltman L and Van Eck N J, Constructing bibliometric networks: A comparison between full and fractional counting, *Journal of Informetrics* 10 (4) (2016) 1178-1195. https://doi.org/10.1016/j.joi.2016.10.006
43 Price D J D S, Little Science, Big Science (Columbia University Press; New York), 1963.
44 Van Leeuwen T N, Moed H F, Tijssen R J W, Visser M S and Van Raan A F J, Language biases in the coverage of the Science Citation Index and its consequences for international comparisons of national research performance, *Scientometrics* 51 (2001) 335-46.
45 Saldanha G, Ranganathan between philosophical and epistemological dilemmas, *Bibliothecae.it*, 12 (1) (2023) 142.
46 San Segundo Manuel R, Sistemas de Organización del Conocimiento: La Organización del Conocimiento en las Bibliotecas Españolas (Universidad Carlos III; Madrid), 1996.
47 Martínez-Ávila D, Ibekwe F and Bochi F, The Epistemic Communities and Evolution of Knowledge Domains: A Domain Analysis of the Journal Education for Information, *In Knowledge Organization at the Interface* (Ergon Verlag; Baden-Baden), 2020, p. 264-273. https://doi.org/10.5771/9783956507762-264
48 Ibekwe F, Bochi F and Martínez-Ávila D, Mapping the Evolution of Topics Published by Education for Information: Interdisciplinary Journal of Information Studies, *Education for Information* 37 (4) (2021) 545-563. https://doi.org/10.3233/EFI-211559.
49 White H D, Authors as citers over time, *Journal of the American Society for Information Science and Technology* 52 (2) (2001) 87–108. https://doi.org/10.1002/1097-4571(2000)9999:9999<::AID-ASI1542>3.0.CO;2-T
50 Beghtol C, Facets as Interdisciplinary Undiscovered Knowledge: S.R. Ranganathan in India and L. Guttman in Israel". *Journal of Documentation* 51 (1995) 194-224.
51 Vickery B C, Faceted Classification (ASLIB; London), 1960.
52 Vickery B C, Faceted Classification Schemes (Graduate School of Library and Information Science, Rutgers University; New Brunswick, NJ), 1966.
53 Gilchrist A, Brian C. Vickery, *In ISKO Encyclopedia of Knowledge Organization*, 2019. Available at https://www.isko.org/cyclo/vickery.
54 Satija M P, S. R. Ranganathan and the method of science (Aditya Prakashan; New Delhi), 1992.
55 Hjørland B, Facet analysis: the logical approach to knowledge organization, *Information processing & management* 49 (2) (2013) 545-57.
56 Hjørland B, Is Facet Analysis Based on Rationalism? A Discussion of Satija (1992), Tennis (2008), Herre (2013), Mazzocchi (2013b), and Dousa & Ibekwe-SanJuan (2014), *Knowledge Organization* 41 (5) (2014) 369-376.
57 Garfield E, Current Comments. A Tribute to S. R. Ranganathan, the Father of Indian Library Science. Part 1. Life and works, *Current Contents* 6, February 6 (1984) 5-12; and *Essays of an Information Scientist* 7 (1984) 37-44. http://garfield.library.upenn.edu/essays/v7p037y1984.pdf
58 Garfield E, Current Comments. A Tribute to S. R. Ranganathan, the Father of Indian Library Science. Part 2. Contribution to Indian and International Library Science, *Current Contents* 7, February 13 (1984) 3-7; and *Essays of an Information Scientist* 7 (1984) 45-49. http://www.garfield.library.upenn.edu/essays/v7p045y1984.pdf

Annals of Library and Information Studies
Vol. 71, March 2024, pp. 92- 104
DOI: 10.56042/alis.v71i1.8992