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A Reflection on the Applicability of Google Scholar as a Tool for Comprehensive Retrieval in Bibliometric Research and Systematic Reviews

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Abstract

Google Scholar has recently attracted great attentions as an open access multidisciplinary citation database, and a tool for retrieving scientific works for scientometricians and researchers. The present research intended to highlight the limitations brought about by efficiency policies of the search engine and its impact on the results available to users. To do so, it examined the accessibility of the retrieval results, through conducting 54 searches in this database. The results showed that the estimation of the results on the top of the first page returned by Google Scholar did not match that of the accessible results. Therefore, these statistics could not be accounted for to precisely determine the number of documents on a topic. Moreover, the results showed that although the subjects selected for the searches were very specific, the number of results for each search was very wide and exceeded the upper limit of 1,000 records authorized in Google Scholar for display. By limiting the searches to the title field, the number of the results was dramatically reduced. Since title is one of the most important representations of document contents in scientific and technical fields, this strategy can increase the precision of the results and thus the effectiveness of the retrievals. The investigation of the accessibility of the search results for the title field also showed that some documents, though scarce in number, were still inaccessible despite the fact that they were within the 1000-record limits. In addition, in title field search, some rare cases of duplicate records, incompatibilities between queries and documents were observed regarding the language of the documents and exact phrase search. The lack of automatic truncation in field searches was one of the most important issues necessitating the use of sophisticated search strategies.

Keywords: Information Retrieval, Google Scholar, Accessibility, Bibliometric Studies, Systematic Reviews.

Introduction

A thorough, yet comprehensive, identification of literature review is one of the important factors in the research process (Anders & Evans, 2010). In fact, having a strong literature review and using high-quality scientific sources are among the important factors in accepting articles, especially in prestigious journals. Scientometricians and systematic reviewers are among the researchers needing a comprehensive and thorough identification of scientific works. Although subject classification of journals facilitates the identification of resources in subject areas, they are not accessible or applicable in all areas especially in very specific subjects. Besides, the predefined classification of disciplines or subjects suffer from some deficiencies in determining subject boundaries which make it difficult to ensure the precision and comprehensiveness of the system. Determining the subject boundaries depends, therefore, on the retrieval methods necessitating sophisticated search strategies (Glanzel, 2015). Scientific search engines are among the tools which assist the realization of this important issue.

Since 2004, when Google Scholar (GS) was derived from Google, many studies have been conducted on its strengths and weaknesses, especially compared to commercial databases. Although the results of the initial research were not satisfactory, recent research have suggested a dramatic improvement in the citation coverage of this database (Chen, 2010; Gehanno, Rollin Darmoni, 2013; Harzing, 2013a; Harzing, 2013b), the relevance of the results (Adriaanse & Rensleigh, 2011; Bar-Ilan, Levene, & Lin, 2007; Garcia-Perez, 2010; Kirkwood & Kirkwood 2011; Meier & Conkling 2008; Shariff et al., 2013), and their precision and recall rates (Walters, 2009; 2007). These features make GS a powerful tool for comprehensive searches of literature reviews (ibid).

However, no study has investigated the comprehensiveness of the accessibility of the retrieved results in GS. By “the comprehensiveness of the accessibility” we mean displaying and providing all the retrieved articles’ information. This information may be accessible in at least one of the levels of full text, bibliographic information, abstract, and snippet. The need to investigate the accessibility roots in the fact that the GS database is actually a public web search engine, and continues to operate in the public web environment. Hence, contrary to the commercial databases, which perform on a selective limited number of resources, GS continues to rely on unlimited various web resources. One of the prerequisites for performing in the web environment is the adoption of policies to maintain the system’s efficiency. Efficiency refers to the ability of the system to perform properly considering the consumed resources (ISO / IEC, 2001). In information retrieval, the system's efficiency i.e., its ability to perform the retrieval tasks, is measured through considering the amount of the consumed resources, computing power, response time, and energy (Bessis et al., 2012; Frieder, Grossman, Chowdhury, & Frieder, 2006; Stefani & Zenos, 2008; van Zwol & van Oostendorp, 2004; Verhoeven, Steehouder, Hendrix, & Van Gemert-Pijnen, 2010). Creating inverted indexes, query optimization, and distribution of processing on multiple machines are among the ways to improve systems’ efficiency (van Zwol & van Oostendorp, 2004).

One of the policies to maintain efficiency is that search engines roughly report the number of retrieved results and do not yet display all the estimated results because on the one hand, it may reduce the system’s efficiency, and on the other hand, users are believed to not often browse more than the first a few retrieved pages. Therefore, reporting all the results would not be useful to them. Studies have mostly focused on the effectiveness of results because if the system is not effective, the user will turn away from the system no matter if it is efficient or not (van Zwol, & van Oostendorp, 2004). However, the system's efforts to maintain efficiency can be problematic for some retrieval purposes, especially bibliometric research and systematic reviews, because in such retrieval tasks, the user wants to verify (almost) all retrieved results.

Using GS's data retrieved for Sotudeh and Houshyar (2018), the present study tries to demonstrate how the system's efficiency observations affect the accessibility of GS search results in free searching (via full text keywords) and title field searching. By accessibility, we mean displaying the items retrieved, so that the user can view the title and the related snippet among the results list. Moreover, some instances of inconsistencies of the results with the search strategies will be reported.

The significance of this study relies on its emphasis on the necessity of adoption of special and conscious approaches to use GS as a comprehensive tool for bibliometric research or systematic reviews. In GS, up to 1000 results (100 pages, each containing 10 records) can be displayed. Therefore, it is obvious that in the search of general topics, a large percentage of the results is not expected to be accessible for systematic reviewers or bibliometricians. However, in the searches limited to very narrow topics, the total number of existing records are lower. Consequently, the total number of retrieved results are expected to get reduced, and thus a satisfactory amount of the records be available for reading or analyzing. The paper shows that even for narrower topics, searchers cannot rely on the GS results, due to its displaying limits. As a result, searching by title field, which is believed to retrieve more relevant records and yield higher precision has priority on free searching of topics. The present research also tests the reliability of the reported results estimation in order to be used in bibliometric research. Bibliometricians could trust the statistics provided by GS if the maximum number of the retrieved documents is displayed to check and ensure the identification and verifiability of resources.

Literature review

Google created GS by separating its scientific and general resources indexes in 2004. Providing users with literature from a variety of resources, including books, abstracts, technical reports, etc., GS is considered as a scientific tool for identifying scientific and quality works in the academic community (Friend, 2006). GS is an exemplar of web-based, multi-disciplinary, open and automatic citation indexes. Contrary to such commercial citation databases as Web of Science (WoS) and Scopus, it goes far beyond indexing scientific journals and covers citation and bibliographic data of non-serial resources such as conferences, research projects, dissertations, pre-prints and books. This database is able to automatically establish relationships between cited and citing sources, and play the role of a citation index in the Web retrieval. A wide number of GS's scientific citations are accessible in full text and free of charge in the Web environment. GS results are ranked by their relevance to the searched queries. Unlike Google's search engine, GS has a priority in ranking results based on citation relations and not just on the visiting or linking rates on the Internet. Consequently, GS has two main advantages: it not only is an information retrieval tool with precise and advanced algorithms, but also provides resource evaluation opportunities through citation analysis techniques (Friend, 2006; Notess, 2005).

In addition to Boolean search operators, and language and time limitation facilities, GS has developed some search facilities to improve the effectiveness of the retrieved results. Among them, spelling correction, automatic truncation, and recently field search, make GS much closer to commercial scientific databases. For instance, search in the title field of papers or journals (e.g., intitle: citation or allintitle: citation analogy or publication: IJISM[1]) will provide results that contain the keyword or terms in the titles. Or searching in the author's field (e.g., author: Glanzel) will offer documents which are written by a particular author. Furthermore, features such as "related documents", "cite" with a variety of citation styles, *"my library"*, or the choice of document types (e.g., article, case law, patents and citation) have made GS more and more effective for researchers.

Other benefits of this open scientific database include the dramatic increase in its citation and publication coverage. Earlier studies had criticized the coverage of GS database in terms of the lack of comprehensiveness (Jacso, 2005a, 2005b, 2005c), especially the weakness in the coverage of older works (Meier and Conkling, 2008), bias in favor of science and technology disciplines, as well as English resources. However, more recent findings have shown more comprehensive coverage (up to 100% of the surveyed resources) (Chen, 2010; Gehanno et al., 2013; Harzing, 2013). Orduña-Malea et al (2015) estimated the coverage of GS to be about 160-165 million documents. Besides, Martín-Martín et al. (2014) found out that GS cover all document types in all languages from all countries over the world, with 40 percent of highly cited ones being accessible. Jamali & Nabavi (2015) found out that about 60 percent of full-texts were available on GS.

GS outperforms some databases such as PubMed (Shariff et al., 2013) in terms of the coverage of some subjects (Walters, 2007), and the relevance of the retrieved results; while evaluated to be parallel to some databases such as WoS, Scopus (Adriaanse & Rensleigh, 2011; Bar-Ilan, Leven, & Lin, 2007; Garcia-Perez, 2010), Compendex (Meier, & Conkling 2008) and BIOSIS Previews (Kirkwood & Kirkwood 2011). According to Bakkalbasi, Bauer, Glover, & Wang (2006) the mentioned three databases do not have certain superiority over each other regarding the retrieval of citations and the choice of the best database depends on the publication year of the articles as well as the subject under review.

In a study, Shultz (2007) showed that despite the superiority of GS, this database cannot be a substitute for PubMed, but can be a good complement for medical searches (ibid). However, the recent findings of Gehanno et al. (2013) revealed that GS can be a leading source for medical searches and systematic reviews (Gehanno, et al. 2013). Currently, most of the WoS articles are available through GS, making it an invaluable resource for preparing literature reviews (De Winter, Zandpour and Dodou, 2014; Mikki, 2010). Particularly, GS's precision and recall are more than those of many commercial databases, including WoS (Walters, 2009; 2007). As a result, GS's growing advancement is believed to put WoS in jeopardy. For instance, WoS' selectivity policy may fail against the rapid progress of knowledge on the Internet, while it is in favor of GS which performs on web-based, rather than selectively gathered, resources. Furthermore, in the near future, GS is going to cover all WoS journals. Thus, due to the benefits of GS in terms of full text searches and extensive coverage of a variety of resources, especially non-serial ones, this database would be the first source of search (De Winter et al., 2014). In addition, another threat would be presented in terms of the presentation of research evaluation metrics. As Harzing and van der Wal (2008) showed, there is a strong correlation between the impact factor of journals in WoS and

[1] Searching in journal titles is just provided in the "advanced search" section, and cannot be formulated manually as "publication: X"

measures such as the H-index, G-index and mean citation in GS. This fact, along with the free accessibility to GS, can lead to the democratization of citation analysis.

Despite its many benefits, this database has been criticized from a variety of perspectives. For instance, due to the automatization of the process of citation identification, GS is subject to citation errors as well as non-academic resource coverage (Cathcart & Roberts, 2005; Donlan & Cooke, 2005; Jacso, 2005a; Vine, 2006; Wleklinski 2005; Lopez-Cozar, , Robinson-Garcıa, & Torres-Salinas,, 2012). The fact which is due to the lack of quality control in GS makes its utility as a bibliometric tool doubtful (Aguillo, 2012). Furthermore, in the retrieved results, recurring and false positive records are found (De Winter et al., 2014), which make the refining and selection of resources difficult for a researcher. Additionally, this database is known to be vulnerable to manipulation of citations (Beel and Gipp, 2010; Labbe, 2010; Lopez-Cozar et al., 2012). Moreover, despite the great improvement in the coverage of this database especially regarding open access articles (Jamali & Nabavi, 2015; Martín-Martín et al., 2014), open access journals (Mayr, & Walter, 2007) and institutional repositories (Arlitsch & O'Brien, 2012) are not sufficiently indexed in GS. Moreover, although the efficiency of this database in medical disciplines has been approved, in some areas such as respiratory care, GS has less precision than PubMed (Anders & Evans, 2010). In laser medicine, the results of this database are more relevant than those of Scopus, although they are aligned in terms of the importance of retrieved sources (Tober, 2011); the relevance of the results in GS is also weaker than that of EBSCO's Academic Search Premier (Callicott, & Vaughan, 2005).

Although GS has been widely investigated in terms of its comprehensive publication and citation coverage, overlap with quality databases, and results relevance and precision and recall, no study has explored the comprehensiveness of the accessibility of the results retrieved by GS as well as the correspondence between the retrieved results and the selected search strategy. More specifically, previous research considered accessibility in terms of comprehensive coverage of the index as well as open access to full text; however, no research has been conducted to examine the accessibility of the results retrieved through GS.

Method

The present study followed a webometric method with a webometric approach. The purposeful sample were taken from Sotudeh and Houshyar’s (2018) study, in which 54 queries containing 19 homographs were examined in GS. The searches were done between 2/2015 and 3/2015, were limited to English, and dated between 2000 and 2015. They were conducted in two modes of field search (limited to title field), and free search (throughout the text without any field restriction). The keywords and search strategies used are presented in the appendix.

An important point about the search strategies used is that in the first attempts to design the search formulas, there was evidence of search results indicating that the truncation facility was not followed at least in title field search in GS. Therefore, in formulating these strategies, derivatives, plural and singular forms as well as synonymous words were considered. However, since the purpose of the present study was not to identify and review all the documents on these topics, there is no claim for the comprehensiveness of the strategies.

As previously mentioned, regardless of the number of estimated results for each search, only 1000 items are accessible in GS. In both of the stated search strategies, all items up to the final pages were verified in order to examine their accessibility.
The number of retrieved results in GS was measurable based on the following three criteria:

1. The number of estimated results displayed at the top of the first page of the results, along with the time spent to respond;
2. The number of results based on the number of pages displayed at the bottom of the search pages multiplied by the number of records in each page. In GS, each page can contain 10 records (by default) or 20 records (user's choice). Obviously, depending on the total number of results, the number of records in the final page may be less than this value.
3. The number of displayed records which is obtained by counting every single result.

Findings

Free search

Although the searches were limited to very specific thematic phrases and specific timeframe, the number of free search results was very large and beyond the limit of 1,000 records accessible in Google's Scholar. In general, for the total 54 searches conducted, 22272090 search results were estimated in the free search. Only 52,876 results (0.022% of the total results) were accessible in the first 100 pages. Therefore, in the free search, one cannot expect a significant percentage of accessible results based on the keywords in the full text of the articles. Hence, bibliometricians or a systematic reviewers can count on the reported results in the first 100 pages, hoping that the documents ranked at the top of the results, are mostly relevant to the searched topic. The accessibility of the results in the first 100 pages is discussed in the following section.

Accessibility of the results in free searching mode

Typically, the number of initially reported results is expected to match that of the results on the final page. However, in the majority of the searches through both of the search strategies (i.e., free and title-field search), this correspondence was not observed. In fact, the number of accessible results _ whether compared to the number of estimated results at the top of the initial page or compared to the reported results on the last page _ was different.

Besides, some of the 1000 records, though scarce in number, were inaccessible. As it is shown in Figure 1, in the free search strategy the inaccessible percentages range from 0% to 8.2%. Totally, in the free search mode, 52876 records (i.e. 97.92% of the total records) out of the expected total of 54,000 records (i.e. the number of searches multiplied by the first 1000 records), were accessible. Thus, assuming that GS's relevance ranking algorithm is effective and the most relevant documents are successfully ranked at the top of the results, it can be hoped that a significant percentage of these relevant documents are accessible in the first 100 pages.

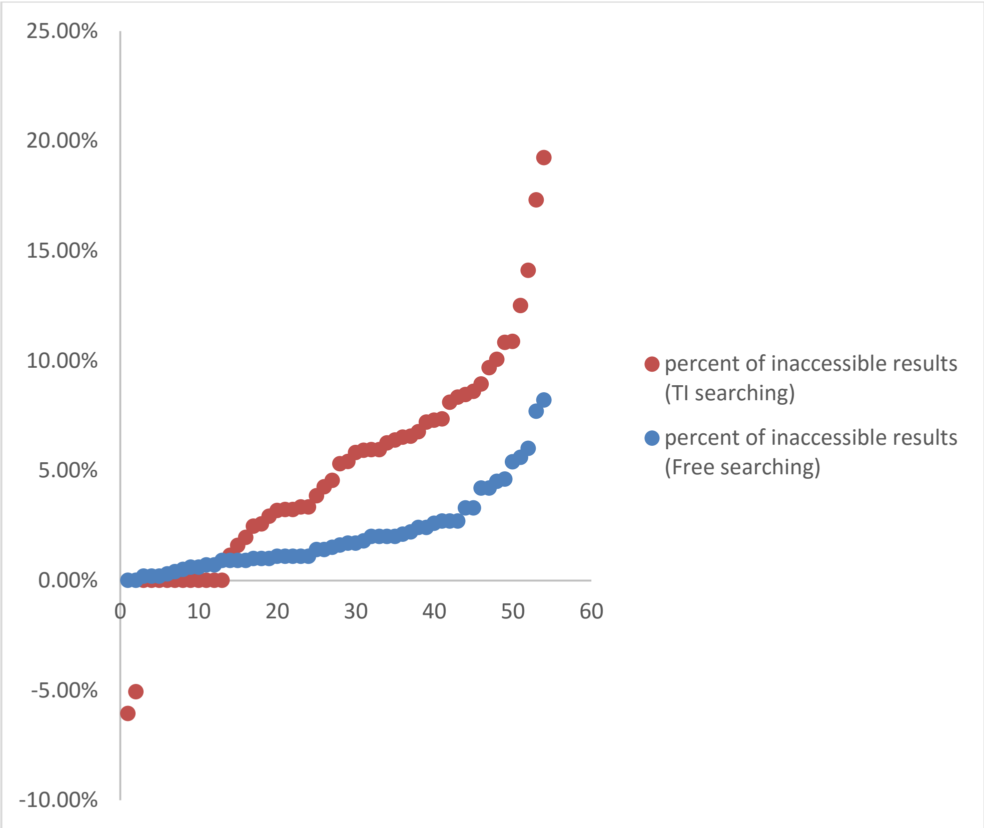

Figure 1. The percentage of inaccessible results in free and title-field search strategies

Field search accessibility

Title is one of the most important representations of the subject of a document, especially in scientific and technical texts. Using title-field search is, therefore, an effective strategy to reduce the number of results retrieved while increasing their relevancy and precision.

As it is evident, the results brought about by the title-field searching were very small compared to the results yielded by free searching (ranging from 0.001% to 2.26%). Just in one search, the percentage of the accessible results researched to 10.87%. A total of 5435 records were estimated to exist for 54 searches. 5215 records (96%) appeared in the result list, and 5115 records (94.99%) were accessible. Therefore, only about 5% of the results were totally inaccessible. Figure 1 also shows the status of the inaccessible results for the title-field searching. The inaccessible percentages range from -6.06% to 14.11%. For instance, the search for "fetal stem cells" led to the retrieval of 160 documents. Although the number of documents was small, GS displayed only 146 documents in the result list, and provided 140 accessible documents. Therefore, out of the 160 reported results on the home page, 20 documents were not accessible. In general, one to 20 documents were not accessible in the searches. In 41 out of the 54 searches, there was a mismatch between the estimated and the accessible results.

Ironically, in two searches, the number of reported results in the final page was higher than the initial estimated results, leading to the negative values for the inaccessible records in Figure 1. In the search of "football matches", the initial estimated results at the top of the home page was 132, the number of results displayed at the bottom of the search pages was

140, and the number of accessible results was 140. In the search on the subject "batting in cricket", the initial result number was estimated to be 79, the same number was displayed in the final page; however, the number of accessible results was 83.

Compliance with the search strategy

Realistically, the keywords or phrases used in the field search must be presented and should be highlighted in the related field (Title field in the present study, labeled as "allintitle") of the retrieved results, so that the searcher can easily track his keywords. Although the searches in the present study were limited to titles, a total of 146 retrieved records (3%) did not contain search terms in their titles. For instance, in the "prison cell", the word "*cell*" has not been observed in the following title retrieved with the search formula of *allintitle:(prison OR jail OR prisons OR jails) (cell OR cells):*

"Mixed Advice on Nanotechnology: Activist Group Wants Cloned Animals Closely Regulated: Animal Activists Sentenced to Prison: Zimbabwe Changes Attitude to"

Duplicate records: Typically, it is expected that in any subject area, each title appears only once in the retrieved results. However, one of the reported weak points of GS, as a bibliometric tool, is the emergence of duplicate records. In some field-search results retrieved, a number of titles repeated several times. This led to an erroneous estimation of the results. The number of repeated results in a total of 54 searches was 60 (i.e., one percent of all field-search results), which indicates a low rate of replication.

Language adaptation: Although the search strategy was limited to English, 326 items of the retrieved results (6%) were not in English; they were retrieved due to the translation of their titles to English.

The exact search: One of the strategies that can be effective in reducing the number of results as well as increasing the effectiveness of search is the exact phrase search. This strategy will maintain the relationships between the search components; consequently, the meaning will not be lost. Whenever this strategy is used, it is expected that the phrase would repeat in the searched field exactly as it is used in the quotation marks. However, this did not happen in several of the retrieved documents. For instance, in the search for "terminal patients" through the formula of *allintitle:"terminal patients" OR "terminal patient"*, a number of documents were retrieved, with none of the highlighted and exact phrases in their titles. In 5 of the 54 searches inconsistencies were observed, including “terminal patients” (69 hits), “terminal cables” (14 hits), “tree trunks” (40 hits), “bass model” (14 hits), and “exact matches (9 hits)”.

Automatic truncation: Although it is claimed that GS, similar to Google, supports automatic truncation (Burright, 2006), the results of the searches showed that it was not applied at least in field searches used in the present study. For instance, if such facilities had been applied, searches for the word "muscle" would have been expected to result in either "muscle" or "muscular" retrievals. However, as much as the investigated results showed, it did not happen. The failure in applying the automatic truncation cannot be a limitation specific to the compound searches, but perhaps to the field search. Because, when searched separately in the same searching time, "*muscle*" led to 62 records, while “*muscles*” led to just 34 records, though they were expected to result in the same or similar number of results.

Conclusion

In this study, GS was examined in terms of the comprehensiveness of the results' accessibility, and their consistency with the search strategy. The findings showed that in most searches, the number of initial results estimated at the top of the first result page did not conform either to that displayed at the bottom of the pages or to the total number of accessible documents. This discrepancy indicates that the estimated results on the first page do not show the actual value in GS, even for very specific topics.

These inconsistencies can be attributed to the dual nature of the GS database. GS is basically a branch of a public web search engine, i.e. Google, although, it is focused on scientific resources, and continues to rely on unlimited web resources, unlike commercial databases with a limited selective coverage. Thus, it should inevitably be in line with the requirements of searching in the public environment. One of the requirements is that search engines roughly report the number of retrieved results to maintain their efficiency. Furthermore, they do not display all the estimated results. Therefore, it is more beneficial to rely on these statistics just as an estimate close to reality.

In addition, the results showed that even in very specific subject searches, the number of results of free search in full text is very large and far beyond 1,000 threshold of displayable and accessible records based on GS's policy. Given the fact that the search engine ranks the results based on their relevance to the queries, it is hoped that the first 1000 results are the most relevant ones. The investigation of the accessibility of these 1,000 records in 54 searches revealed that a very high percentage of these records (97.92 %) was accessible. However, what is specifically questionable to the bibliometricians and systematic reviewers is the relevance degree of the first 1000 retrieved results compared to other inaccessible records. The most important point is that due to the dynamism of subjects and the diversity of the documents written about each subject, one cannot consider a single all-purpose cut-off. Therefore, even if the relevance of the first 1000 records is established, bibliometricians and systematic reviewers cannot simply ignore the records following 1000.

Therefore, in order to keep away from the doubts about the effectiveness of free searches as well as the relevance of the first 1000 documents, bibliometricians and systematic reviewers are recommended to limit their subject searches to specific fields such as date, title, author, or journal. In this study, the accessibility of the search results in the title field was examined. The findings showed that although the number of searches showing the discrepancy between the estimated results and the accessible ones is very high, the total number of the affected records is not very high and is about 5% (i.e., the acceptable random error in sampling).

Moreover, unexpected errors (e.g., non-compliance with the user's chosen language, or lack of exact phrase search), implying Google's failure to comply with the search strategy, were observed in a small number of the records. A very small percent of duplicates were found among the title-field searching results. However, the lack of automatic truncation seems to be the most important issue. When designing search strategies, GS did not seem to follow automatic truncation in field searches _at least in the title field search which was the focus of this study. Ironically, this is contrary to what is reported for the journal and author field searching by Harzing (2017). As she mentioned, GS unnecessarily truncates the fields, and thereby affects the effectiveness of the retrieved results. However, in the title-field searching, when a topic search is meant and not the exact title of a paper, the facility is desirable. Therefore, in order to comply with precautionary considerations, searchers need to use sophisticated search strategies consisting of synonyms, derivatives and variations when by title searching they mean a specific “topic” and not a specific “title”. As a result, to have a beneficial search, familiarity with Boolean search principles, GS's facilities, and the vocabulary of the specialized field is strongly needed. Therefore, in addition to the need to increase their information literacy level, bibliometricians are in a need to cooperate and interact with subject specialists, or use knowledge bases such as thesauri or ontologies.

The present study has been conducted at a micro level. Given the fact that the inconsistencies rooted in GS's attempts to maintain the system’s efficiency, this situation is likely to be more dramatically observed in more general searches or searches which yield massive results. In this case, bibliometric research and systematic reviews based on this database will face with difficulties because the policy’s default is based on general users’ behavior on the web. Usually, users do not see more than the first a few pages of the results (Ma, Wei & Chen, 2011; Wang, Shan, Lei, Xie, & Li, 2001; Ye, Chua, & Kei, 2003; Zhang, Pang, Xie, & Wu 2006). Hence, displaying a huge number of records is not reasonable in terms of both users’ needs and resource consumption. However, the default does not seem reasonable for users with specific needs e.g. bibliometric studies or studies requiring a comprehensive literature review (e.g., systematic reviews). Therefore, while the results of this study indicated an ignorable lack of accessibility and compliance, more research is required to verify the problems in larger meso or macro scales.

It should be noted that the effectiveness of the searches of Google as a tool for conducting bibliometric research or literature reviews strongly depends on the search strategy used. Very specific or limited searches in particular fields can improve the effectiveness of the results. However, in cases where the subject matter is not very specific, it may not be useful to even narrow down the search to a particular field because too many results (beyond the first 1000 displayable records) may be reported, resulting in a significant inaccessible number of documents. Therefore, it is necessary to examine and find search strategies appropriate for general subject areas and the free searches which are primarily used for conducting bibliometric research or literature reviews (Glanzel, 2015). GS also needs a more advanced search facility to become a comprehensive tool for conducting bibliometric research.

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Appendix: the search strategies and results

NO	Query	Search strategy	Title-Field Searching			Free Searching		
			Accessible results	No of hits provided in the pages returned	Estimation of retrieved results	Accessible results	No of hits provided in the pages returned	Estimation of retrieved results
1.	embryonic stem cells	embryonic stem (cell OR cells) (blastocyst OR blastocysts)	140	146	160	980	72300	72500
2.	polymer organic solar cells	polymer organic solar (cell OR cells)	270	278	287	1000	538000	538000
3.	Protein Data Bank (PDB)	"protein data bank"	190	200	202	979	174000	178000
4.	Breeding in rams	(ram OR rams) (breeding OR mating OR sexual)	190	192	202	980	220000	206000
5.	Cell phone usage when driving	cell (phone OR phones) driving	140	144	151	993	205000	207000
6.	Ship boards	(ship OR ships) (board OR boards)	248	250	266	973	1479000	1480000
7.	Prison cells	(prison OR jail OR prisons OR jails) (cell OR cells)	62	62	63	944	241000	255000
8.	Mining query logs	mining query (log OR logs)	87	87	87	991	133000	134000
9.	River banks erosion	(river OR rivers)(bank OR banks) erosion	210	211	220	994	328000	330000
10.	Terminal patients	("terminal patients" OR "terminal patient")	170	170	189	918	9010	9820
11.	Bank credits and financial crises	bank credit ("financial crisis" OR "financial crises")	43	46	46	983	17500	16200
12.	Ram memory	(ram OR rams)memory	130	136	142	998	515000	517000
13.	Ram pressure in Galaxies	"ram pressure" Galaxies	58	60	60	1000	9190	9190
14.	Bus terminal	(terminal OR terminals) bus	120	125	128	998	5620000	5690000
15.	Cord terminal	"cord terminal" OR "cord terminals" OR "cords terminals" OR "terminals of cords" OR "cable terminal" OR "cable terminals" OR "cables terminals" OR "terminals of cables"	58	58	60	976	3340	3390

NO	Query	Search strategy	Title-Field Searching			Free Searching		
			Accessible results	No of hits provided in the pages returned	Estimation of retrieved results	Accessible results	No of hits provided in the pages returned	Estimation of retrieved results
16.	Tree trunks	"tree trunks" OR "tree trunk" OR "trees trunk" OR "trees trunks"	200	201	208	985	1810	1840
17.	frozen elephant trunk	frozen elephant trunk	100	100	103	967	9380	9700
18.	Strengthenin g trunk muscles	(trunk OR trunks) (muscles OR muscular OR muscle) (strengthening OR strength OR strong OR strengthened)	86	86	104	993	186000	188000
19.	Bats auditory	(bats OR bat) auditory	116	122	125	995	35600	35800
20.	baseball bats	baseball (bat OR bats)	170	175	186	958	59800	62400
21.	arms muscles	arms (muscles OR muscle OR muscular)	100	100	102	973	35500	365000
22.	cultured sea bass	cultured "sea bass"	81	83	86	996	18800	18900
23.	bass music	bass music	60	60	62	946	134000	130000
24.	bass diffusion model	"bass model" OR "Bass diffusion model"	140	148	157	940	6060	6190
25.	Bass Strait	Bass Strait	79	79	81	986	20800	21100
26.	measuring eye pupil	eye pupil (size OR measure OR measuring OR measurement)	35	35	37	991	200000	202000
27.	bench press	bench press (muscle OR muscular)	42	42	52	997	70100	70300
28.	press advertiseme nts	press (advertisements OR advertising OR advertisement)	140	147	163	973	2940000	3020000
29.	Balls velocity	(ball OR balls) velocity	170	176	185	991	536000	541000
30.	ball mills	("ball mills" OR "ball mill" OR "ball milling") nanotubes	61	61	63	990	15300	15600
31.	eye balls	("eye ball " OR "eye balls")	41	41	46	955	12300	12900
32.	copper circuits	copper ("circuit boards" OR "circuit board") (recovery OR recycling)	56	56	62	974	14300	14700

NO	Query	Search strategy	Title-Field Searching			Free Searching		
			Accessible results	No of hits provided in the pages returned	Estimation of retrieved results	Accessible results	No of hits provided in the pages returned	Estimation of retrieved results
33.	web bugs	(bug OR bugs) web	51	51	56	989	220000	224000
34.	Spiders' web building	web (building OR construction) (spider OR spiders) -"web-building spiders" -"web-building spider"	22	22	24	989	98300	101000
35.	Android web applications	android web (app OR apps OR applications OR application OR software)	38	38	39	990	92400	93500
36.	palm oil	("palm oil" OR "palms oil") Biodiesel production	180	183	188	994	17500	17600
37.	palm print recognition	palm print recognition	57	57	61	990	76100	77000
38.	Palm [operating System]	palm (OS OR "operating system")	60	60	62	978	84800	86800
39.	Islamic banking interests	islamic banking(interest OR interests)	44	44	47	984	152000	141000
40.	mole crickets	mole (cricket OR crickets)	125	130	132	980	10300	10500
41.	computer terminal	(terminal OR terminals) computer	101	109	109	980	2640000	2700000
42.	batting in cricket	cricket (bats OR batting)	83	83	79	976	14900	15300
43.	football matches	football matches	140	140	132	982	119000	122000
44.	bed bugs control	(bug OR bugs) bed control	35	35	35	983	66600	67700
45.	Females in editorial boards	editorial (board OR boards) (women OR gender OR females OR female)	28	28	28	989	2940000	2730000
46.	fermi ball	(ball OR balls) (fermi OR fermion)	13	13	13	989	49800	50400
47.	ball and socket joints	ball socket (joint OR joints)	49	49	49	986	25500	25900
48.	saw logs	saw (logs OR log)	32	32	32	923	638000	690000
49.	Bayesian log linear	Bayesian "log linear"	21	21	21	991	24800	25100
50.	Hydraulic rams	"Hydraulic ram" OR "hydraulic rams"	30	30	30	958	7340	7660

NO	Query	Search strategy	Title-Field Searching			Free Searching		
			Accessible results	No of hits provided in the pages returned	Estimation of retrieved results	Accessible results	No of hits provided in the pages returned	Estimation of retrieved results
51.	arms racing	arms (races OR racing OR race) (atomic OR nuclear)	38	38	38	954	143000	138000
52.	pupils mathematics performance	(pupil OR pupils) mathematics (achievements OR achievement OR performances OR performance)	71	71	71	989	211000	213000
53.	exact matches [information retrieval]	"exact matches"	49	49	49	998	21100	21100
54.	water banking	water banking	55	55	55	967	342000	353000
Total			5115	5215	5436	52876	22174030	22272090