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Optimal Search Strategy for Research on Misinformation and Fake News: A Comparison between Search Systems and Keyword Choices

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Abstract. This paper explored the issue of identifying the right keyword and search engine or database to help communication scholars gain optimal experience and obtain the best outcomes in literature searches on the topic of misinformation and fake news. Five major types of electronic search systems were evaluated for their precision (relevancy), recall (sensitivity), and duplication rates. They included discovery layers such as Summon, web crawlers such as Google Scholar, library databases such as EBSCO Academic Search Complete, Journal publisher website search, and specialized journals using 14 keywords to search for the same topic. Based on the findings, Summon and *HKS Misinformation Review* had the highest relevancy ratings. It was notable that Google Scholar only ranked 6th for the 14 keywords analyzed. The two main keywords- "misinformation" and 'fake news' had a lower relevancy rating compared to the other keywords like 'infodemic' and 'news propagation' which had the highest relevancy scores. The lack of overlap in listing using different keywords and different search systems demonstrated that there was no single all inclusive, top search engine and that using a variety of terms and different search systems was necessary to conduct a thorough literature review on the subject. The study's findings and their implications for conducting literature searches by researchers in the Global North and the Global South were also discussed.

Keywords: Search systems, Databases, Misinformation, Fake news, Keyword search, Relevancy, Recall, Search strategy.

Introduction

In this digital age where research output is retrieved mainly by keywords in search systems, it is important to find the right keyword and the right search system to do a comprehensive literature search on the topic (Gusenbauer & Haddaway, 2020). In the field of communication, there is little systematic research on how the different search systems and databases affect research results except for some evidence or concerns on newspaper databases such as Lexis Nexus vs Google News (Weaver & Bimber, 2008), and Factiva vs. Lexis Nexus (e.g., Zhang & Ha, 2021).

With the ever-growing research output in academic journals and other platforms, especially online, the problems of finding the right keyword and right search systems during literature search are further exacerbated. First, databases/search systems use unknown algorithms in selecting and ranking the sources. Users must assume the algorithm is the best for that particular keyword or topic. Second, source coverage is unknown in web crawler searches such as Google Scholar. Traditional databases usually provide the subscribers with the list of sources they use. However, as Ewald (2004) discovered, how deep and updated the databases are in retrieving information from various sources varies by the databases. Finally, although paid databases such as EBSCO's Academic Search Complete offer useful searches, many entries retrieved have embargo limitations that users cannot retrieve the full text of the article published in the past 18 months or those that are published early online such as online-first or earlycite articles. Hence the cost of the databases to the subscribers or users and the accessibility of the latest articles by these databases are an issue. The subscription model of library databases limits access to institutional users, while web crawlers such as Google Scholar are free to anyone with internet access. Hence, users who are not affiliated with universities or users in developing countries with poor access to databases tend to rely on free sources such as Google Scholar.

As academic journal publishers are increasing their presence online either as solely online journals or providing users with digital access to their print and online versions of the journal on their websites, they also create their search engines to facilitate the search of journal articles of the family of journals published by the same publisher. For large publishers that have thousands of journal titles such as Wiley, SAGE, and Taylor and Francis, their collection is as large or even larger than some databases.

This study uses an important communication topic: Misinformation and fake news, which is gaining worldwide attention from different disciplines due to the proliferation of social media and other types of false and inaccurate information online (Ha et al., 2021; Himdi et al., 2022), as a case study to examine how the use of different search systems and keywords cause differences in search results on research on the topic. Through the comparison, the study hopes to identify a good literature search strategy for communication researchers on the topic or other communication topics. Moreover, even though misinformation is an interdisciplinary topic, Ha et al.'s (2021) review of research articles in the past 10 years found that communication scholars contributed the greatest number of articles on the topic.

Types of Search Systems and Databases

There are five main types of electronic search systems and databases that researchers commonly use to do their literature search: 1) discovery layers, 2) web crawlers, 3) library databases, 4) journal publisher websites, and 5) specific journals online search engine/browsing.

I. Discovery layer: Summon. Librarians and library users have experienced an evolution in web discovery services. Like other web-scale discovery search products, Summon provides a pre-harvested main index that allows users to search across a library's book and journal holdings through a single search box (Ciccone & Vickery, 2015). It enables individuals to access a wealth of academic content through a simple, user-friendly

interface. Furthermore, it simplifies the discovery of library collection and institutional resources.

Contrary to other databases, abstracts, and indexes, summon services are leveraged through an extraordinary match and merge technology that combines numerous types of data from various sources and creates a single record optimized for discovery. For subscribers, its unique approach exposes abstract and indexing resources to more users and directs researchers to full text when available while maximizing the value and usage of abstract and indexing content for libraries. The match and merge technology combines, normalizes, and corrects from multiple sources full text and metadata like abstracts, subject terms, thesauri, controlled vocabularies, citations count, and more data (PR Newswire, 2013). Therefore, converging the information improves relevancy and increases the discoverability of content in case a user wants to uncover information through natural language queries or database-specific controlled vocabularies. s-ummon has a central discovery index that is pulled from publisher content, repositories, etc. In the researchers' university, its version of Summon is a combination of centralized content and content that is dependent on its local subscriptions.

Boyer and Besaw (2021), in a study done at East Carolina University (ECU) to determine the usability of patrons' perceptions and use of Summon discovery tool, indicate that Summon provides users with seamless connectivity available within a single search and increases their utilization of library resources. In another study, Meredith (2013) found that Summon's single search box provides the simplest method to uncover known items.

II. Web crawlers - Google Scholar. Google Scholar (GS) was launched in 2004 by Google for scholarly literature searches. GS enables researchers to uncover different materials, including books, journals, abstracts, theses, and technical reports from dynamic fields. It contains an essential "cited by" indexing citations to the scholarly search query within its coverage (Dash, 2005). Furthermore, it provides links to the authors' content. Also, GS users may access permissible full text of scholarly search results. In addition, the web searches the general internet-based information linked to the query item. Publishers may index their scholarly content through Google and GS to improve visibility and publications' accessibility.

III. Library Databases

Although databases are important resources offered by libraries to serve users in finding research articles on a subject, not all databases are as useful. Different databases compete for library subscriptions. Ewald's (2004) study aimed to find out how many unique studies are offered in each of the databases across the subjects and whether there are overlapping similar subject studies in the databases for Communication, Sociology, and Music by comparing the unique titles and common titles shared by databases. After the results were analyzed, the author suggests that "caution must be taken whenever dealing strictly with numbers of titles indexed by databases, as the depth of indexing will vary greatly." (p. 19). The titles found in these databases are not always updated or current and periodicals are often dropped by these databases. So, it does not always give a representation to a title of study in a periodical. The author also states that one of the shortcomings of the study was that a definitive list of periodicals was not available for the compared databases. Another problem was that the

databases did not provide an idea about the level of coverage of titles in them. A study examining differences between Scopus and Web of Science finds that when only smaller citing entities (e.g., journals, conference proceedings, institutions) are considered, the two databases produce very different results, whereas when larger citing entities (e.g., research domains, countries) are considered, the two databases produce very similar scholarly impact pictures (Meho & Sugimoto, 2009).

EBSCO. According to Worldwide Databases (2019), EBSCO is a discovery service provider with over 11,000 customers in more than 100 countries. The researchers' university subscribes to its Academic Search Complete service, which is a multi-disciplinary full-text database that includes scholarly journal articles on all subjects as well as magazines, books and book chapters, reports, conference proceedings, and other sources. Its coverage includes 3,486 active full texts of non-open access journals. However, only one-third of the journals it included have no embargos (EBSCO, 2021).

Communication and Mass Media Complete Database. The database provides refined and quality research solutions in communication and mass media. It contains the content of CommSearch and Mass Media articles indexed together with other journals in communication, mass media, and other related fields. It is a research and reference resource of broad scope and depth encompassing a breadth of the communication discipline (Brooks & Herricks, 2007). It offers cover-to-cover indexing and abstracts for over 390 subscription-based journals and open access journals for a combined coverage of about 600 titles. Also, CMMC includes the full text without embargo of over 285 journals at the time of study. It contains a sophisticated Communication Thesaurus and comprehensive reference browsing. Moreover, the database features over 3,000 author profiles, containing biographical data and bibliographic information, where it covers the most prolific, highly cited, authors who are frequently searched for in the database.

Article First. The database indexes articles from the table of contents of about 12,500 journals, including a list of libraries holding the journal title (Li, 2000). The articles cut across numerous fields, including science, technology, medicine, social sciences, humanities, and popular culture. It is free to libraries as part of the Online Computer Library Center (OCLC) service. Each record describes one article from a journal. Most records provide a list of libraries that hold the journal-title. *Article First* is a database for articles adopted by the researchers' university library which now boasts a search of 16,000 multidisciplinary journals from the OCLC FirstSearch service that comes with the library subscription of the OCLC service (OCLC, 2021).

Google Scholar and Its Comparison with Other Library Databases

Most studies comparing search systems for research focus on comparing Google Scholar and other library databases or citation indexes. The review of Halevi, Moed, and Bar-Ilan (2017) on different studies comparing GS and other databases found that they focused on different areas including coverage, citations, author profiles, and metrics. In coverage, GS was shown to have more articles covered including those in non-English languages. In addition, compared to other databases, GS is a great web crawler that collects and indexes scientific output through publishers' websites or from scientific repositories of academic institutions' catalogs and other websites that contain academic and scientific literature. The review also

showed that GS was ahead of the rest in covering subject-specific sources as well as multidisciplinary subject areas and social sciences in comparison with popular databases like Scopus and Web of Science (WOS). However, GS was found to omit relevant literature that was available on publishers' websites and a delay was notable in publishing literature from subscription-based platforms vs open-access articles. While WOS and Scopus index peer-reviewed scholarly information, GS indexes all literature whether peer-reviewed or not. Therefore, it captures all types of literature including research reports, white papers, presentations, and blogs. Thus, when measured for impact, GS naturally displays more citations than other databases. When investigating GS's ability to distinguish spam or 'junk publications' from real scientific literature, the review also found studies that uncovered fake documents were uploaded and picked by GS as valid, thus indicating that GS does not have quality control policies. Therefore, it is evident that GS results can be manipulated by individuals since there is no existing quality control. In addition, it has also been found that GS results contain errors in meta-data and duplicated records.

Comparing the quality of the results of databases and Google Scholar (GS) which is a web crawler, Howland et al. (2009) found the results of Google Scholar have higher scholarliness scores than citations found in most library databases. Scholarliness of the results was evaluated with the help of a scale based on Kapoun's model such as "(1) accuracy, (2) authority, (3) objectivity, (4) currency, (5) coverage, and (6) relevancy."

GS has attracted significant attention based on its features like free access and multidisciplinary bibliographic literature. However, at the subject level, library databases seemed to outperform GS. A study by Kirkwood & Kirkwood (2011) comparing GS with the specialized subject database EconLit found that GS is not better than the subject database and that the two search systems use different ways to interpret relevance. The study by Walters (2009) shows one of the disadvantages of GS is uncontrolled vocabulary for subject terms and lack of authority for author names and journal titles. Also, it contains inconsistency in handling Boolean operators and the inability to seek the literature by other criteria other than relevance. Ten bibliographic databases were found to return more results than GS. An evaluation of the literature coverage revealed that GS failed to cover the most recent information sources. However, it contains more literature but not necessarily scholarly or relevant. A recent study by Hughes (2018) still found that web search crawlers such as Google Scholar cannot replace library bibliographic databases. The study found that web search engines do not necessarily use Boolean logic and in general have limited functionality compared to bibliographic databases.

However, in the coverage of some specific subjects, GS was found to be a better search tool than other databases. For example, a systematic study comparing the quality of 10 databases and GS on the area of child protection social workers' resilience finds Applied Social Sciences Index and Abstracts, Social Services Abstracts, and Social Sciences Citation Index (SSCI) is the most sensitive databases, and they returned more than twice as many results as any other database (Mcfadden et al., 2012). However, regarding the first 100 entries, Google Scholar exhibited moderate sensitivity and high accuracy. On subjects such as geography (Ştirbu et al., 2015), open access materials for medicine (Nourbakhsh et al., 2012; Rahimi &

Chandrakumar, 2014), and agricultural economics (Salisbury & Tekawade, 2006), engineering (Meier & Conkling, 2008), GS also showed better coverage than other search tools.

Harzing & Alakangas's (2016) study is a systematic and comprehensive comparison of the coverage of the three major bibliometric databases: Google Scholar, Scopus, and the Web of Science. It was conducted between 2013 and 2015 investigating how the use of different data sources and the choice of different metrics affects research performance across disciplines. It found GS is more interdisciplinary and Scopus and Web of Science are more subject-specific. (Martín-Martín et al.(2021) shows GS is still the most comprehensive data source among the six databases: Google Scholar, Microsoft Academic, Scopus, Dimensions, Web of Science, and OpenCitations' COCI. Their investigation of 3,073,351 citations identified 2,515 English-language highly cited articles published in 2006 from 252 subject categories. Among the databases and GS, GS was the only one that found 88% of all citations, many of which were not detected by the other sources.

Comparing citations of GS, the WoS Core Collection, and Scopus to 2299 English-language highly-cited publications from 252 GS subject categories published in 2006, an earlier study (Martín-Martín et al., 2018) also finds GS consistently retrieved the highest percentage of citations (93%–96%) across all sectors, greatly outpacing Scopus (35% –77%) and WoS (27% –73%). Google Scholar found nearly all of the WoS (95%) and Scopus (92%) citations. Most citations discovered by GS were from non-journal sources (48–65%), such as theses, books, conference papers, and unpublished materials. Many of them were non-English (19%–38%). Despite all these comparisons in past literature, none were on the subject of communication.

IV. Journal publisher websites. In addition to databases, major journal publishers also provide their proprietary search engine for users to search articles that the publisher publishes as a walled garden (results will only come from articles of the publisher's journal family). In the field of communication, SAGE, Taylor and Francis, Wiley and Oxford Academic are major publishers.

SAGE is the world's leading independent academic publisher and publishes more than 1,000 journals (SAGE, 2021). Most of the articles it publishes are in arts humanities, and social sciences. Its article search provides a permalink to the author's details, abstract, and title as well as metrics such as the number of citations of the article.

Wiley is a global provider of content and content-enabled workflow solutions across different fields including life, health and physical sciences, social science, and the humanities. It publishes 1,600 journals, half of which are published in partnership with prestigious international scholarly and professional societies (Wiley, 2021)

Taylor and Francis is a journal publisher of over 2,700 journals (Taylor & Francis, 2021), including the global program of social science and humanities journals published by Routledge. It cuts across applied science, technology, and medicine content (Li & Lee, 2014).

Oxford Academic has been growing with the evolution in technology, ensuring researchers have access to up-to-date content in the most convenient format. It publishes over 450 journals in the humanities, social sciences, law, science, and medicine, two-thirds of which are published in partnership with learned and professional societies. Oxford Academic

contains the highest percentage of journals in the top 10% by impact factor and the lowest percentage of journals in the lowest 50% among publishers with over 100 journals in the ISI Impact Factor ranking (Oxford Academic, 2021).

V. Specific journal search: *HKS Misinformation Review*

The Harvard Kennedy School of Government launched *HKS Misinformation Review* in 2020 as a new online journal dedicated to research on misinformation, which is the topic of this study. It has a digital search engine. Hence our study compares how a specialized journal on the topic fared in user experience and article relevancy in comparison with other broader-based search services.

Common metrics used by scholars in comparing search systems are their precision and recall. While recall (or sensitivity) is the percentage of relevant article entries that are returned in the result set from all relevant records known to exist, precision (or specificity) is the percentage of records in the result set that are relevant (Gusenbauer & Haddaway, 2020)

However, most research comparing search systems focuses on the number of citations (coverage) and quality of the articles retrieved, but not much about the common user experience in the search.

Research Questions

To help communication researchers find the most effective way to find relevant literature and compare the strengths and weaknesses in the search results of each search system, we developed the following research questions for our study:

1. Which search system yields the most relevant results to the topic of study? Among databases, which one is the best? What is the best publisher journal search?
2. Which keyword can yield the best results in finding research that can create a misinformation metric?
3. How similar are the search systems (overlap in results and ranking)?
4. What are the strengths and weaknesses of each search system based on the available features and user experience?

Research Method

To test the effectiveness of the different search systems, we decided to choose the topic of misinformation and fake news, which has the characteristics of broad interest from many disciplines (Ha et al., 2021) and has also many different terminologies that refer to the topic so that we can use a variety of keywords for it to test the result. After a brainstorming session by the research team and reviewing articles on the topic, we identified 14 keywords to search for the topic: “rumor,” “hoax,” “fake news,” “false news,” “misinformation,” “conspiracy theory,” “disinformation,” “deep fake,” “fact check,” “infodemic,” “news sharing,” “news propagation,” “post-truth” and “media literacy.”

A team of 10 coders used different search systems to locate the search results using these keywords. The search systems that we decided to use were:

1) Discovery layer - Summon

2) Web crawler - Google Scholar
3) Databases - EBSCO's *Academic Search Complete*, *Communication and Mass Media Complete*, and *Article First* to search for articles in the authors' university library.
4) Journal publisher search engines: We chose SAGE, Wiley, Taylor and Francis, and Oxford Academic because they are the largest in communication and have a well-developed website and search function within their walled garden of journals published by their company. They are free and open to the public and have links to important metrics about articles such as citations, abstracts, etc. If the article is open access, then the user can immediately get full text after the search. They are the more recent players that have not been studied in search system research but are potentially important for academic users if they search the journal's website.
5) Specialized journal: *HKS Misinformation Review*

Measurements

Relevancy: We determined the relevancy of the result to the topic by reading the text of the abstract provided in the search results/article listing. This is because most users determine whether they will continue to read the full text by the relevancy shown in the abstract. We provided a rating of 0 for totally irrelevant results, 1 for somewhat relevant results, 2 for relevant results and 3 is highly relevant that will be included in a research paper on the topic.

Recall: The average number of entries listed in the search results for each keyword in the search system.

Duplication: The similarities in the identified articles using the same keyword between the systems.

Similarities and Difference in Ranking: For articles that were included in more than one database using the same keyword, we counted how similar or different in the ranking or included/excluded in the search result listing ranking.

Quality of the article: The number of citations for the retrieved article.

During the search, we avoided the use of Boolean operators because not all search systems use Boolean operators and most users do not use Boolean operators in their search (Lowe et al., 2018). In comparing the different search systems, we employed a method similar to Nourbakhsh et al. (2012) which utilized typical search methods of an average user, evaluating abstracts only from up to the first 30 listings for every search, determining its relevance and quality. Relevance was determined from the abstract and rated by the coders based on subject knowledge. The raters were master and PhD students with research interest in misinformation.

We used "Misinformation" as a keyword and Google Scholar as the search system to illustrate how relevancy was determined. The article, Ackoff, R. L. (1967). Management misinformation systems. *Management Science*, 14(4), B-147. https://doi.org/10.1287/mnsc.14.4.B147 was ranked first in the GS search result listing. The article had 2,317 citations which may explain why it was listed on the top. But it was about correcting deficiency in computer management information system, not about misinformation as we understood it. So, it was rated as 0, not relevant, by the coder. Another article, Schuler, S., Choque, M., & Rance, S. (1994). Misinformation, mistrust, and mistreatment:

Family planning among Bolivian market women. *Studies in Family Planning*, 25(4), 211-221. doi: 10.2307/2137904, was about how women received misinformation about family planning. It was rated as 1 as somewhat relevant, because it was indeed about effect of misinformation, but would not be directly useful for development of a metric measuring misinformation. Mian, A., Khan, S. (2020) Coronavirus: the spread of misinformation. *BMC Med* 18, 89. https://doi.org/10.1186/s12916-020-01556-3 was rated as 2, relevant for the study of misinformation dissemination. But it does not contain specific measurement of misinformation. For the article Vicario, M. D., Bessi, A., Zollo, F. (2016). The spreading of misinformation online. *PNAS, 113* (3), 554-559. https://doi.org/ 10.1073/pnas. 1517441113, it was rated as 3, highly relevant, because it focused directly on spreading of misinformation that the result and measurement were useful for research on misinformation dissemination.

Findings

A total of 2,102 entries were found using the 14 keywords in the 10 search systems. For each keyword, we allowed up to the top 30 listings only so that we could read all the abstracts manually. We then compared the average relevancy rating of all the abstracts retrieved from each search system and each keyword.

Which Search System Yielded the Best Search Results on the Topic of Misinformation?

We used relevancy, coverage (recall/number of entries), and impact of the articles included (number of citations) as the three criteria in evaluating search systems.

To our surprise, Summon, which is not a subject-based interdisciplinary search system and a discovery layer system, was rated as most relevant in the entries on the topic of misinformation and fake news using the 14 keywords (average rating = 2.55). The quality of the articles, as indicated by average article citations, was also the highest among all search systems (See Table 1).

Table 1. Relevancy rating comparison by source.

Source	Av. Article citations	Average Relevancy Rating	Av. Number of entries per keyword
Summon	246.78	2.55	9.357
Google Scholar	216.7	1.89	30.0
Comm & Mass Media Complete	N/A	1.566	20.69
EBSCO	N/A	2.14	18.46
Article First	N/A	0.3155	20.0
SAGE	Additional step needed	1.836	23.0
WILEY	Additional step needed	2.51	18.0
All Oxford Academic	6.80	2.217	5.0
Taylor and Francis	10.19	1.6179	22.5
HKS Misinformation Review	11.88	2.54	7.0

The second-best search system in relevancy rating (precision) is a specialized journal on misinformation: *HKS Misinformation Review* (average rating = 2.54). This was expected because the journal is dedicated to misinformation and the keywords we used easily could be found in the articles of that journal.

Wiley as a science and social science journal publisher site was rated the third best in relevancy. It was the best journal publisher site in relevancy. However, its number of entries was the second lowest among the four journal publisher websites (average entries per keyword = 18). SAGE had the highest number of entries per keyword, average entries per keyword= 23, followed by Taylor and Francis, with an average of 22.5 entries per keyword.

Google Scholar, as one of the most widely used reference sources, was only rated 6th in relevancy rating.

Among common library research databases, subject databases such as *Communication and Mass Media Complete* showed good coverage (recall) with an average of 21 entries per keyword, but the precision/relevancy was a bit low with an average rating of 1.57. EBSCO *Academic Search Complete*, as an interdisciplinary database, was rated higher in relevancy than all other library databases with an average rating of 2.14.

Which keyword provides the best result?

We compared the 14 keywords we used to search articles on the topic of misinformation and fake news. See Table 2. To our surprise, "misinformation" or "fake news" as keywords did not get the best result. Their average relevancy ratings were lower than other keywords such as "infodemic", "news propagation," "information sharing," and "disinformation." "Infodemic" and "news propagation" were the best rated in relevancy in the article abstracts retrieved by the researchers.

Retrieved Article Duplication Rate

There was very low duplication between the keywords even when they looked highly similar. We paired up similar keywords such as "Fake news" and "False News," "Rumor" and "Hoax," "News sharing" and "news propagation", "misinformation" and "disinformation". "infodemic" and "news propagation", and found very few to no duplication. "Misinformation" and "disinformation", have only four duplicated articles out of 281 articles using the keywords. "News sharing" and "news propagation" have only two duplicated articles out of the 234 articles using the keywords. The other keywords such as "hoax" and "rumor," "fake news" and "false news" have no duplication at all. See Table 3.

With almost no duplication in the top 30 entries both between keywords and search systems, it seems that each search system used different algorithms to rank and select articles for each keyword. Originally, we tried to compare the ranking of the listings between search systems. The low duplication made such a comparison meaningless to conduct.

User Experience of the Search Systems

In addition to the above ratings of relevancy (precision), we also examined the user experience in using each of the search systems. For the discovery layer such as Summon, the researcher had a great experience with all the keywords. Using the relevant keywords along

with the filters such as "full-text", and "peer-reviewed" among others, Summon gave relevant search results. The results shown were from a variety of databases and the citation could easily be procured from the researcher's university library.

Table 2. Relevancy rating comparison by keyword.

Keyword	Average Relevancy Rating	Number of entries
DISINFORMATION	2.229	135
MISINFORMATION	1.888	146
FACT CHECK	1.59	85
FAKE NEWS	2.11	147
FALSE NEWS	2.017	144
HOAX	1.325	136
INFORMATION SHARING	2.285	30
NEWS PROPAGATION	2.305	130
RUMOR	2.085	147
CONSPIRACY THEORY	1.34	178
DEEP FAKE	2.146	102
INFODEMIC	2.318	82
MEDIA LITERACY	1.445	86
NEWS SHARING	2.176	104
POST TRUTH	2.11	187

Table 3. Duplication by keyword pairs.

Keywords	Number of duplications
Fake News/False News	0
Rumor/Hoax	0
News sharing/News propagation	2
Misinformation/Disinformation	4
Infodemic/News propagation	0

For web crawlers such as Google Scholar search, one of the researchers found the keyword searches for "rumor," "news sharing," and "news propagation" showed many latest journal articles and books by the search engine in the top 30 list. Also, multidisciplinary, and inter-disciplinary articles with the associated keyword were shown as results. Another

researcher using Google Scholar for keywords such as "media literacy," "false news," "hoax," and "post-truth," experienced similar convenience and high coverage. However, it was also pointed out that some of the citations in Google Scholar were incomplete without volume, issue, and page number. Thus, the researcher had to get access to the full journal article to get the complete citation. Also, there were certain instances when the researcher found that the citations given in Google Scholar didn't match the citations given on the exact research paper. Another researcher using Google Scholar for searching with keywords "fake news", "misinformation" and "infodemic" found it very convenient to search relevant articles. However, the researcher found that search results with the keyword "infodemic" were not cited much because the word only gained popularity recently after COVID-19. Also, the researcher found that many citations listed by Google Scholar were incomplete. One other researcher using Google Scholar for keywords like "fact-check," "conspiracy theory," "deep fake" and "disinformation" echoed the same opinions. Many of the citations generated automatically by Google Scholar were incomplete, and some had abstracts missing. However, for most of the search experience, the researcher found the results relevant to the keywords and some of the articles were very recent. The "advanced search" feature of Google Scholar can be very useful for scholars looking for relevant articles.

For databases such as *ArticleFirst*, one of the researchers searched with the keywords "fact-check," "rumor," disinformation," "fake news," "misinformation," "infodemic," "hoax," "conspiracy theory," "deep fake," "information sharing," "news sharing," "news propagation," "post-truth,", "media literacy," and "false news," found that the interface of the database was difficult as it did not allow the use of certain filters for articles in English. Also, most of the search results found didn't have APA citations altogether or had it incorrectly done. Besides, many articles didn't have any abstracts. It was considered the worst user experience among all the search systems under study.

For *Communication and Mass Media Complete*, the researcher searched all 14 keywords through EBSCO host. The researcher noted that the user interface is good, making it easy to look for relevant articles with the keywords and filters. Also, the results shown are a combination of the most recent ones and those that are older, thus giving a lot of relevant results for the required searches.

Journal Site Search Experience

For the Wiley website journal publisher search engine, there were many filters to choose including subject, author, journal title to choose, and the listings are all relevant to the topic. The number of citations to the article was displayed next to the article title.

For the Taylor and Francis website journal publisher search engine, the researcher searched using all the keywords to find relevant articles for each of them including the most recent ones. However, the problem was to find the full citations manually for each of the articles found.

For the SAGE website journal publisher search engine, the researcher searched with the keyword "Fact-check" and found that the "most cited" articles gave the most irrelevant searches whereas choosing on a "relevance" basis the top search results were all SAGE's open access journal articles. There was a clear bias in the journal's search algorithm favoring its open-access

journals. But SAGE also facilitates users to share the article citation in various social media and e-mail and enables users to choose five different citation styles for the complete citation of the article and export them to five bibliographic software such as RefWorks, Endnote, etc. Even for articles without full text, there was a list of related articles for the researcher.

For the All Oxford Academic website journal search engine, the search experience was a bit difficult as the researcher had to sift through a long list of results to identify the relevant ones. Even the researcher tried the filter of 'most relevant', but it gave the researcher irrelevant stuff. All Oxford Journals entries were from articles in medical and health journals.

For specialized journals such as *HKS Misinformation Review*, the search experience was generally good. The researcher had a great search experience with the *HKS Misinformation Review* search engine as it gave the latest and extremely relevant articles, editorials, and reports.

It should be noted that several research team members worked from their home countries which are Global South countries (Bangladesh, India, Ghana, Kenya and Nigeria) during the search process so they could not use the U.S. university library databases but only Google Scholar or journal web sites like many other Global South users.

Discussion

The goal of our study is to identify the best search strategy for misinformation and fake news for research purposes. From our comparison, it seems that there is not a well-rounded or superior search system that fared well above all others in relevancy, recall, and impact of articles. *Summon* is the best in user experience. It fared well in precision and number of citations of the articles listed but was low in recall of articles. Its integration with a library's database and collection offers users a seamless experience. So, for university researchers with libraries that adopt Summon, it will be a good choice to start with. However, the users would be unlikely to be satisfied with its low number of entries for each keyword. Because it retrieved fewer articles, researchers are recommended to supplement search systems that maximize the number of articles with another high coverage/recall search system such as Google Scholar (the highest in entries) or journal publisher websites with good recall rates such as SAGE and Taylor and Francis. The comparison in the study also found a negative relationship between relevancy (precision) and number of entries (coverage/recall). Search systems that retrieve highly relevant results usually have a lower number of entries.

Low Overlap in Listings

We were shocked at the lack of overlap or duplication of the listings. Even for the same keyword such as "misinformation," there were very few duplications across search systems in both interdisciplinary and subject databases. Apart from the different sources used by each system, the different algorithms for selecting relevant articles probably caused such totally different results. So, researchers on the topic of misinformation must at least consult several search systems to get the most relevant references even if only the same keyword is used. The keyword that resulted in the highest relevancy is "infodemic." "Misinformation" and "fake news" only ranked sixth and seventh in relevancy. For highly similar words such as "fake news" and "false news," "news propagation" and "news sharing," there was still little to no overlap at all. As the algorithm for choosing the articles is not open to the public for all these search systems, we were not able to explain why the algorithm retrieved different articles for

the same keyword in different search systems apart from their different coverage of articles. Due to this lack of replication, researchers using keywords to retrieve literature must justify why those keywords were the best and why they selected certain systems. If exhaustiveness or highest coverage is the goal, then the researcher must try to use databases and search systems that give the most entries such as Google Scholar and journal publisher websites such as SAGE. But if retrieving the most relevant literature is the goal, then *Summon* or EBSCO *Academic Search Complete* or specific journals on the topic should be used.

In assessing the user experience, coders found the use interface design is very important apart from relevancy and coverage. A good design makes it easy for users to find what they need quickly. Among the search systems, Database *Article First* has the worst interface design which is difficult to navigate so it was rated the worst by our research team members in addition to its low precision and low recall rate. Moreover, many of its citations were incorrect. Full text, number of citations or even abstracts are not available. Summon's easy to use interface and immediate access to article was an enjoyable experience for the team member even though the number of retrieved entries were small. Google Scholar was quite well-received by our team members because it is an easy-to-navigate database and can add filters such as publication year and citation style options to the results for searched items. However, it also has incomplete or wrong citations. On the other hand, *Summon*, with its filters of "full-text," and "peer-reviewed" among others, gave relevant search results. For *Communication and Mass Media Complete*, there were relevant filters to look for with the keywords, making the search experience pleasant. However, for journal site user experience, Taylor and Francis, SAGE publisher website, and All Oxford Academic Journals, because of lack of relevant filters, a lot of irrelevant results were elicited by the keywords. Wiley was the best in user experience. *HKS Misinformation Review* was good in terms of the relevant and current results that it gave along with the required filters. It also has a list of 52 topics for users to find relevant articles. However, identifying specialized journals requires prior subject knowledge. It may not be feasible for novice researchers on the subject. Overall, *Summon*, *Communication, Mass Media Complete,* and *HKS Misinformation Review* are the best search systems offering the best user experience with good filters, relevant keyword searches, current results, and correct complete citations.

Limitations and suggestions for further research

Despite our research's contribution to the search systems in retrieving research on misinformation and fake news, there are some limitations in our research. Relevancy or number of citations is not the same as content quality, although relevancy and citations can be components of content quality. The abstract of an article was used as the determinant of relevancy rating in our study, not the full article. Although an abstract does not show the rigor and details of the full study, it provides important cues to the users whether the article may contain valuable information for them to spend more effort in retrieving the full article. Hence a poorly written abstract will greatly reduce its full article readership in literature search because of perceived irrelevance or low quality.

One other aspect we did not cover in the study but is increasingly important is the recommendation systems in journal websites or other academic research sharing sites such as ResearchGate and Academia.edu or even Google Scholar. Journal publishers certainly want more users to use their journal family and are highly invested in cross-promoting different

journal articles of their journals through recommending related articles on the same topic. Recommendation systems offer researchers easy alternatives or related articles to consider. However, the recommendation system is another black box algorithm that users do not know of. If users may specify the recommendation preference such as the same author or the same keyword, then recommendation may be a time-saving tool to the researchers and users can have an active role in the recommendation algorithm process. Another external factor we could not address in this study is the change of algorithms of the search system overtime and the consistency of the algorithm. The journal article embargo period of databases also made it unsuitable to access the full text of the latest research.

Recommendation for Optimizing Literature Search on Misinformation to Global North and Global South Scholars

The lack of consensus to retrieve research literature on misinformation and fake news shown in the study is troubling to knowledge advancement. It is hard to build a common body of knowledge or standards to evaluate the state of research of a field without a way to identify and retrieve a set of common past and current research on the issue. Instead of building knowledge on the shoulders of giants, we may be reinventing the wheels by not knowing past research on the topic exists using different search systems and keywords.

The good news is that our study shows that with online access, the accessibility of research to developing countries can be greatly improved with the variety of search systems available. Many of them are free, especially the overlooked resources of journal publisher websites that have not been examined in previous studies. Based on our study results in considering user experience and quality of the search results, we recommend Global North researchers to use a strategy of first trying several high-precision search systems such as *Summon*, specialized journals, and EBSCO *Academic Search Complete*. After combining the listings, the researcher would have a good idea of the state of research on the topic. Then users may broaden the search with Google Scholar and then select the most relevant ones from the large number of entries and journal publisher websites which have the latest articles.

For Global South scholars who have limited or no access to databases, we recommend that they start their literature search using Google Scholar and the free journal publisher web site available online to build a bibliography list first with abstracts. Then users can select the most relevant articles and may write to the authors directly to request the full article if the article is not open access, and their library does not subscribe to the journal. Then the gap between rich countries and poor countries in access to the latest research will be reduced. However, our study also shows that journal websites, as walled gardens, have limitations in retrieving most relevant articles to users and some such as SAGE did not do as well as other publishers such as Wiley. But they are freely available to users like Google Scholar and contain complete abstracts, archives, table of contents, and many other journal metrics and in different citation styles for users to choose from. Some even have open-access articles that users can get for free.

The low duplication level of results across keywords and search systems indicates researchers must use multiple search systems and keywords and explain why specific keywords and search systems were used and how they might influence the search results. Some AI-based literature search services such as Elicit and tlooto now try to synthesize online search results

for researchers. Yet their consistency, precision, recall and selection algorithms should be monitored and examined in future research.

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استراتيجية البحث المثلى لإجراء البحوث حول المعلومات المضللة والأخبار الزائفة: مقارنة بين أنظمة البحث وخيارات الكلمات المفتاحية

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المستخلص. تبحث هذه الدراسة في مشكلة تحديد الكلمة المفتاحية ونظام البحث أو قاعدة البيانات الملائمة وذلك بهدف إكساب الباحثين في مجال الاتصال الخبرة المثلى وأفضل النتائج خلال عمليات البحث في الأدبيات حول موضوع المعلومات المضللة والأخبار الزائفة. وعلى هذا الأساس تمت مقارنة خمسة أنواع رئيسية من محركات البحث الإلكترونية وتتمثل في طبقات الاكتشاف مثل Summon، وبرامج الزحف الآلية مثل Google Scholar، وقواعد بيانات المكتبة مثل EBSCO Academic Search Complete، والبحث في موقع ناشر المجلة، والمجلات المتخصصة التي تستخدم ١٤ كلمة رئيسية للبحث عن نفس الموضوع. وقد تم تقييم هذه الأنظمة بالنظر الى معايير الدقة (الملاءمة)، والاسترجاع (الحساسية)، ومعدلات الازدواجية. وقد أظهرت النتائج احتلال كل من Summon وHKS Misinformation Review المرتبة الأعلى في تصنيفات الملاءمة. والجدير بالذكر أن Scholar Google احتل المرتبة ٦ فقط من بين ١٤ كلمة مفتاحية تم تحليلها، وكان للكلمتين المفتاحيتين "misinformation" و"fake news" تصنيف ملاءمة أقل مقارنة بالكلمات المفتاحية الأخرى مثل "infodemic" و"news propagation" والتي حصلت على أعلى تصنيفات الملاءمة. كما أظهرت الدراسة أنه بحكم عدم وجود تداخل في الإدراج باستخدام كلمات مفتاحية مختلفة من خلال أنظمة بحث مختلفة فإنه لا يوجد نظام بحث شامل ومتفوق وأنه من الضروري استخدام كلمات مفتاحية وأنظمة بحث متعددة لإجراء مراجعة شاملة للأدبيات حول الموضوع. وقد تم مناقشة الآثار المترتبة على نتائج الدراسة على إجراء البحوث في الأدبيات للباحثين في شمال الكرة الأرضية وجنوبها.

الكلمات المفتاحية: أنظمة البحث، قواعد البيانات، المعلومات المضللة، الأخبار الزائفة، البحث عن الكلمات المفتاحية، الملاءمة، الاسترجاع، استراتيجية البحث.