Running head: OA search tools for ILL

Comparing open access search tools to improve interlibrary loan fulfillment efficiency

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Abstract: Open access (OA) search tools can expedite the turnaround of interlibrary loan (ILL) fulfillment by locating openly available articles not found by library harvesting tools. Several search tools are available, but no comparison has been done of their efficacy in the context of ILL. Six OA search tools were evaluated using 153 ILL article requests for quantity of openly available articles found, accuracy of results, and value. Article availability was analyzed by publication year and broad academic discipline. Google and Google Scholar outperformed specialty OA search tools, although they were more prone to error and more likely to locate pre-publications.

Keywords: (3-8) interlibrary loan, open access articles, Google, Google Scholar, JURN, OAIster, Open Access Button, OpenDOAR

INTRODUCTION

Given the ease with which information is exchanged in the online environment, academic library users have an increased expectation for the speed with which their interlibrary loan (ILL) requests are filled. Since the vast majority of articles, in particular, are now born digital, a library user may wonder why ILL requests could take any longer than one

or two days to receive. For any given user, gaining instant access to the breadth of scholarly information will likely remain a pipe dream due to the established scholarly publishing complex, in which library collections budgets trend flat or downward while journal subscription costs increase annually. In spite of this, open access (OA) journal articles represent a growing segment of the scholarly literature (Piwowar et al., 2018). ILL departments should consider leveraging existing OA search tools to expedite information retrieval of this content on behalf of their patrons.

Users may find records of articles through library databases but not, due to the restraints of library harvesting tools, be able to identify what full-text content is immediately available via institutional repositories or other OA channels. In order to facilitate the process of locating OA scholarly content, several scholars, students, and librarians have, in recent years, independently and collaboratively developed free online tools that cross-search publisher, repository, and aggregator websites. No published studies have yet analyzed the utility of these tools in locating OA journal articles in the context of fulfilling ILL requests. Could ILL departments make use of these tools in order to locate and provide users with their requests more quickly than by following traditional ILL workflows of submitting requests to other libraries for content that is not already owned by the library?

This study examined the following questions regarding the return on investment of incorporating various OA search tools into an ILL article request processing workflow:

(1) Is it worth investing staff time to seek OA articles prior to following traditional ILL article request workflows?

(2) Is any one OA search tool better than the others at locating freely available content?

LITERATURE REVIEW

Much like how the cancellation of journal subscription has been shown to have little effect on ILL requests (Calvert et al., 2013; Jaskowiak & Spires, 2018; Knowlton et al., 2015), the rise of OA articles has not yet been documented to have a substantial diminishment of ILL requests (Baich, 2015; Mak & Baich, 2016). While some articles are available OA, library link resolvers are not yet sufficiently robust to identify all of the openly available journal article content online due to the challenges associated with linking to a broad range of repositories and unavailable metadata (Sugita et al., 2007), and link resolvers may never be able to fully integrate such a diverse publishing landscape. Librarians are noticing that some incoming ILL article requests are available OA (Espe & Wisniewski, 2019), and ILL managers are recognizing the importance of considering methods to incorporate OA discovery into ILL workflows (Morrison, 2006; O'Brien, 2017). Bowley (2018) writes about initial attempts at integrating such tools into ILL services.

A number of tools that search for OA scholarship have become available over the past decade. While these tools have been reviewed independently (e.g., Condic, 2012; Hoy, 2019a; Keiser, 2018), direct comparison of their utility has only recently been studied (Schultz et al., 2019). Comparison of the efficacy of these tools in the context of ILL is notably absent. When libraries are able to fulfill ILL requests using openly available articles, the savings in time and cost can be impactful (Baich, 2015; Emery et al., 2018; Espe & Wisniewski, 2019).

MATERIALS AND METHODS

Six OA search tools were identified for inclusion in this study based on the breadth or potential niche of coverage. Open Access Button is one of the most expansive of the specialty OA search tools. It was a relatively new tool (launched in November 2013) at the time of data collection for this study in Fall 2017. Its search includes a number of aggregators: Unpaywall Data, Share, CORE, OpenAIRE, Dissem.in, Europe PMC, and BASE (Open Access Button, n.d.). OAIster's description of coverage is a bit more vague, providing records to "open access resources" (OCLC, n.d.). OAIster was included to gain a better understanding of the extent of its coverage of journal article content. OpenDOAR searches OA repositories and describes itself as "the quality-assured, global Directory of Open Access Repositories" (Jisc, n.d.). Like OAIster, the breadth of this tool is unclear. JURN tantalizingly proclaims that it "harnesses all the power of Google, but focusses [*sic*] your search through a hand-crafted and curated index" (JURN, 2020). While JURN's initial concentration was on arts and humanities content, it has since expanded (in 2014-2016) to include science, biomedicine, business, and law.

Google and Google Scholar are included as tools that are known to crawl an extensive portion of the Internet. Google Scholar had been used with some success by this study's author as a final place to locate OA content before submitting ILL requests, both for herself and for library users. Finally, Directory of Open Access Journals (DOAJ) is included in the library's link resolver (SFX) and so is not included in this study.

Citations for ILL article requests were searched across these OA search tools to compare the quantity of full-text articles found and accuracy of the results. From the pool of incoming ILL requests received by the ILL department, the first five article citations

were selected and searched across these six tools each day over a six-week period during September-October 2017. Requests include those from students and faculty. On two days during the data collection period, the ILL department received fewer than five article requests (four articles were received one day and two articles were received in the second instance). On these days, all requested citations were searched. One incomplete citation, one duplicate citation, and one dissertation (i.e., not a journal article) were excluded from analysis. In total, 153 article citations were searched.

A spreadsheet was used to track how full-text access was available for each article. Full-text article access via each of the six OA search tools was tallied. Only the first page of results for each of these search tools was used in this analysis. If no full-text access was available through any of these six OA channels, articles were marked as not openly available. Each article's publication date, journal title, and Library of Congress classification number (when listed in the journal's WorldCat record) were also noted. Library of Congress classification numbers were grouped as: Education (L), Humanities (D, E, M, P), Law (K), Social Sciences (B, G, H, Z), and STEM (Q, R, S, T). Classification numbers not included here were not represented by articles searched in this study.

Only full-text articles that were the final publisher's PDF version of the article were counted as a successful retrieval. Some libraries may choose to include post-prints or other versions of an article as acceptable in fulfilling a patron's request. Each time an OA search tool incorrectly located a full-text article, the appropriate error was noted. In this study, such errors are referred to as "false hits" because, while it appears the article is available from the results page, the result links to something other than the final

publisher's PDF version of the article. These false hits can be either a false positive or a false negative, as described below. False hits were tallied by search tool.

Links to the article abstract only, a paywall on a publisher's website, or a document similar to the article (e.g., a working paper, dissertation, or review of the article) were all considered false hits (false positives). While linking to an abstract only is not a false hit in the context of a search engine locating content, when ILL staff are quickly trying to find full-text articles, it distracts from the discovery process and so is considered a false positive in this study. In some instances, an OA search tool would not discover a known OA article; these were also counted as false hits (false negatives) by that search tool. A small number of "false hits," for two articles in this study, included links to full-text articles that were buried lower on the first page of results and were therefore difficult to identify, a phenomenon exclusive to Google searches. These buried results were counted as false hits (akin to false negatives) since they were challenging to find, and it would be unrealistic to expect an ILL staff member to locate this freely available content without undue effort, although an experienced staff member might be able to deftly navigate such occurrences.

While not false hits, pre-publications were commonly found. For the purpose of this study, pre-publications include both an author's manuscript version of an article and a publisher's page proofs, both of which lack the assigned issue number and finalized pagination. Pre-publications include both pre-prints and post-prints. Neither of these versions constitutes the version of record, and such versions cannot be used by a scholar to create an accurate citation. These versions do not currently satisfy local criteria for ILL fulfillment.

RESULTS

Search tool performance

Of the 153 articles used in this study, 45 (29.4%) were freely available online through OA search tools as the final published PDF (Figure 1). The remaining 108 articles (70.6%) did not meet local requirements for fulfilling ILL requests. This includes: the author's manuscript version (15 articles), the publisher's page proofs (3 articles), the final published HTML version lacking pagination (2 articles), and articles not openly available (88 articles).

[place figure 1 here]

Both Google and Google Scholar retrieved the most full-text articles (31 of the 45 freely available articles, or 68.9%, Figure 2). Of the specialty OA search tools, JURN was the most successful, locating 11 full-text articles (24.4%). OpenDOAR located 5 articles (11.1%) and Open Access Button located just 3 articles (6.7%). OAIster found no OA articles (0.0%).

[place figure 2 here]

Of all the OA search tools, only two located articles not found by any of the other OA search tools (Figure 3). Google Scholar located 11 unique articles (24.4% of all freely available articles); Google found 10 unique articles (22.2%). (While Google and Google Scholar both retrieved 31 total full-text articles, the articles found were different across platforms.) All articles discovered using the remaining search tools were also located by at least one of the other tools used in this study, and either a Google or Google Scholar search always found what the specialty OA search tools (JURN, OpenDOAR, Open Access Button, and OAIster) located.

[place figure 3 here]

Every OA search tool in this study occasionally incorrectly indicated full-text availability for an article. Of all tools, Google had the most of these false hits, with 20 such misidentified results (Figure 4). The next highest offenders were OpenDOAR (13 false hits), Open Access Button (11 false hits), and OAIster (10 false hits). Google Scholar (7 false hits) and JURN (2 false hits) were least likely to have an inaccurate link to full-text content.

[place figure 4 here]

Each OA search tool in this study also identified some pre-publications (pre-prints and post-prints) as the available full-text article. Google and Google Scholar located a greater number of pre-publications (12 each) compared to the other search tools (Figure 5). JURN linked to 5 pre-publications and OpenDoar to 4 pre-publications. OAIster (2 pre-publications) and Open Access Button (1 pre-publication) were least likely to return this type of source in their search results.

[place figure 5 here]

Article availability by publication date

The 153 articles in this study ranged in publication year from 1979 to 2017 (the year data were collected). Articles that were only one or two years old (published in 2016 or 2017) were less likely to be openly available, although, compared to all other years, pre-publications were most readily available from 2016 (Figure 6). Most of the openly available articles in this study were published in the past ten years, although the sample size for articles published more than ten years ago was much smaller than for more recently published articles. The relative ratio by year of openly available articles (final

published PDF versions) to the remaining articles not available for ILL use (including pre-publications and final HTML versions lacking pagination) did not notably change across time.

[place figure 6 here]

Article availability by broad academic discipline

Comparing broadly by discipline, openly available articles were most likely to be in a STEM field (23 out of 65 STEM articles searched, or 35.4%), followed by education (7 of 25 articles, or 28.0%) and the social sciences (15 of 54 articles, or 27.8%). By contrast, no OA articles were found within the humanities (0 of 8 articles, Figure 7).

[place figure 7 here]

Comparing availability by discipline over time, the most current STEM articles (published in the most recent 5 years, 2012-2017, since data collection for this study occurred in 2017) were slightly more openly available than STEM articles published 6-10 years ago (2007-2011), with the oldest content (published more than 10 years ago, 1979-2006) the least available by comparison. For both education and the social sciences, articles published 6-10 years ago (2007-2011) were most likely to be openly available, as compared to articles published most recently (2012-2017) and articles published more than 10 years ago, from 1979-2006 (Figure 8).

[place figure 8 here]

DISCUSSION

Search tool performance

With just over one in four ILL requests in this study freely available online, it is worth

devoting staff time to search for OA content. This is not the first study to find about one quarter of articles to be freely available. Comparing the feasibility of Open Access Button and Unpaywall for use by ILL departments, Emery et al. (2018) located 23.2% of requests through use of these tools, with Open Access Button retrieving slightly more OA content. Piwowar et al. (2018) suggest that, at the time of their study, "at least 28% of the scholarly literature is OA."

In the current study, Google and Google Scholar returned the most results. Google Scholar found the most unique content and had a low number of false hits. Google located the second highest number of unique articles, but had the most false hits. For this reason, Google Scholar will be the easiest tool for ILL departments to integrate into a workflow for locating freely available articles. Despite having a fairly high number of false hits, Google is a good secondary source to use in searching for OA content. Google tends to find news and magazine articles not located by other OA search tools.

The highly specialized OA search tools provide too much of a niche search at this time to be worth using in the context of ILL workflows. In the current study, OpenDOAR linked to full-text content available via PubMed Central, ERIC, and publisher websites, while Open Access Button utilized Europe PubMed Central and a publisher's website. When these tools located articles via institutional repositories, often the full text was not available. Of the specialized tools, JURN was most successful in locating OA content, retrieving author-posted articles as well as articles via PubMed Central, Europe PubMed Central, and ERIC. The OA search tool performance in this study is similar to recent findings comparing Google Scholar, Lazy Scholar, Open Access Button, and Unpaywall, where Google Scholar outperformed the specialty OA search tools (Schultz et al., 2019).

Tools expressly designed to search for OA articles were not as successful as Google and Google Scholar at locating openly available content. In some cases, this is likely because the tool's main purpose is not for indexing journals. OAIster and OpenDOAR are examples of this. OAIster, which is integrated with WorldCat and FirstSearch, contains such material as technical reports, research papers, theses, and image collections. OpenDOAR focuses on content in institutional and subject repositories and does not index e-journals. Also of interest, the Directory of Open Access Journals (DOAJ) integrates with library link resolvers. Once this connection has been set up, DOAJ content is seamlessly discoverable to library users.

Other OA search tools may be more discerning than Google and Google Scholar. Open Access Button does not include content from ResearchGate or Academia.edu. For those who use it, Open Access Button facilitates the process of sending a request to the author to make the article freely available. An earlier review of Open Access Button found that it "can prove buggy" and "odd error messages are commonplace" (Rodriguez, 2019), which is in alignment with how the tool performed in this study. There were a few instances where Open Access Button indicated the article was available but linked to a publisher website with a paywall or a repository where no full text was available.

JURN also proved to be more selective than Google and Google Scholar. JURN searches a curated list of journals. It does not index most commercial e-journals (except those that can "target *only* [emphasis in original] their open access articles"), and while subject coverage has grown in recent years, some disciplines (e.g., educational studies, social studies, psychology) are less well represented by this search tool (JURN, 2020).

Google and Google Scholar were successful because they include content outside the realm of library harvesting tools and seem to cast the widest net in searching for content. In addition to finding the most open content from repositories and publisher websites, in this study both tools frequently linked to author postings of their works. Google and Google Scholar, in one instance each, linked to content from predatory journals, where the other OA search tools did not locate these articles. Occasionally, journal publishers will make individual articles within a journal freely accessible. When this occurred, Google and Google Scholar located the full text, while the other OA search tools did not.

Caution should be exercised with pre-publications. Since a pre-publication is not the version of record, it will lack proper pagination and, in the case of pre-prints, peer-reviewed revisions. Google and Google Scholar located a higher number of pre-publications compared to the other search tools. Neither pre-prints nor post-prints satisfy local ILL criteria, although some users may be content with a post-print. In order to reduce time-to-delivery, ILL departments may wish to consider offering patrons the option to accept a post-print on their article request form, although this could add confusion to an already cumbersome process and leave patrons unsatisfied with the product. ILL staff, too, could face uncertainty in identifying whether a located version of an article is a post-print.

Article availability by publication date

Examining full-text availability by publication year helps to tease apart nuanced patterns within these data. In this study, the majority of article requests were for the most recent years of publication. Articles published within the past year were most often not openly

available, which likely reflects publisher embargo restrictions (Gadd & Covey, 2019; Laakso & Björk, 2013). Among articles that were published prior to the rise of digital technologies – in this study, from the mid-1990s and older – any openly available article was made accessible by the authors on their personally-curated webpages (4 out of 4 articles). Even into the mid-2000s, openly available articles were most likely to be posted on personal webpages by the authors (6 out of 7 articles). From the late 2000s forward, articles in this study became more openly available from subject, institutional, and national repositories, as well as publisher websites. This may reflect an increase in OA journals over time (Liu & Li, 2018), increasing funder mandates to make research publicly available (National Institutes of Health, 2016; Stebbins, 2013), and authors' growing interest, especially among younger and rising academics, in making their research openly available (Dalton et al., 2020; Gaines, 2015).

Article availability by broad academic discipline

The current study was too small to identify generalizable disciplinary trends in openly available article publications, but some interesting patterns can be noted. In the social sciences, while 15 of 54 article requests were openly available, much of this open content was in psychology (6 of 14 requested psychology articles). Two disciplines comprised the remaining majority of social science article requests, and both had much less open content: business, economics, finance, and marketing (2 of 14 article requests were openly available) and exercise science (1 of 7 article requests were openly available). In an international survey, humanities and social sciences researchers were as likely as STEM researchers to be interested in OA publishing for their own research (Rowley et al., 2017). Although within North America and the UK, science, medical, and

engineering faculty were found to be in stronger support of and more likely to publish open access, compared to all other academic disciplines (Dalton et al., 2020; Tenopir et al., 2017; Zhu, 2017). One reason that humanities and social science scholars may lag behind STEM scholars in making their research openly accessible is that they receive comparably less grant funding to finance OA article processing charges (APCs) or they may not see open access as necessary for reaching their intended audience (Dalton et al., 2020; Kieńć, 2016).

In the STEM disciplines, medical articles comprised the majority of openly available content (15 of 42 article requests). This is not surprising, since, following the National Institutes of Health (NIH) open access mandate in 2008, all NIH-funded research must be made publicly available (National Institutes of Health, 2016). One other STEM discipline in this study had more than a few requests: biological sciences (2 of 8 article requests were openly available). Of note, 3 of 4 requested chemistry articles were openly available, despite chemistry being a discipline that has been less eager to embrace OA publishing (Wang et al., 2018). Since the current study is small and only includes articles requested by patrons through interlibrary loan, findings do not represent a universally applicable ratio of open access or openly available content to non-open access or non-openly available content.

Open Access versus openly available

Websites such as ResearchGate and Academia.edu, which allow scholars to post their authored content to a personally curated page, allow for potential error in copyrighted material being made freely available. Even ethicists have difficulty in strictly adhering to copyright compliance; about half (137 of 293) were likely to skirt copyright policy

(knowingly or unknowingly) and post their work online (Laakso & Polonioli, 2018). This demonstrates the moral dilemma many scholars face in considering the dissemination of their research. ResearchGate has been found to be the primary means for accessing full-text articles from Google Scholar (Jamali & Nabavi, 2015; Martín-Martín et al., 2018). Since Google and Google Scholar are more likely to link to this type of content, ILL managers may preferentially opt to use JURN or another high-performing OA search tool to reduce the possibility of sharing illegally posted content. While the "All *x* versions" link associated with Google Scholar results is another way to potentially locate open content (Martín-Martín et al., 2018; Schultz et al., 2019), this method is likely not pragmatic for interlibrary loan staff, due to the extra time required to explore these links.

Publishers including Elsevier and the American Chemical Society (ACS) are taking legal action against these postings, with some success (McKenzie, 2017). A second suit filed by Elsevier and the ACS against ResearchGate is pending judgment (Kwon, 2018). The outcome of this suit may alter the number of freely available scholarly articles that are currently accessible online. Legal action isn't the only way access could change. As Kwon (2018) notes, other journal publishers (Springer Nature, Cambridge University Press, and Thieme) are collaborating with ResearchGate to sort out issues surrounding copyright infringement.

Locating openly available article content online not only reduces the time-to-fulfillment for patrons, it decreases ILL transactional costs. The cost of ILL fulfillment has been estimated at $17.50 per borrowing transaction (Jackson, 2004, p. 31), and more recently as $18.40 per transaction (Emery et al., 2018). While some staff time is needed to search for open content, this cost is minimal in comparison to the potential savings in

borrowing fees, especially when staff can be directed to the most efficient search tool(s) for the task.

Advancements in open access search tools

Data for this study were collected in 2017. In the time that has followed, new OA search tools have been launched and existing tools have been further developed. Some tools are less well suited for use by ILL departments. Browser plugins, such as Kopernio, Lazy Scholar, and Unpaywall, are best employed by individual scholars as they browse for information since these tools require more interaction by the user in order to determine full-text availability (Dhakal, 2019; Hoy, 2019b).

Other tools, like 1findr and Semantic Scholar, while not restricted to exclusively locating OA content, allow users to search the title of an article to determine its availability, much like Google Scholar (Fricke, 2018; Lewis, 2018). This style of searching is better suited to ILL staff who need to quickly check for accessible full-text content prior to determining whether an ILL request must be submitted to a lending library for paywalled content. Publishers, too, are evolving their practice as OA publishing gains traction. One example of this, ProQuest announced in June 2020 that the ProQuest Platform will allow "direct entry from the open web," making it easier for unauthenticated users to access OA content from ProQuest (ProQuest, 2020). As OA publishing continues to increase, the value of reliable OA finding tools will accordingly rise.

CONCLUSION

With one in four ILL article requests found freely available online, results of this study

indicate that incorporating a search for OA articles into a library's ILL fulfillment process is recommended. Not wanting to overcomplicate staff workflow, a recommended method to integrate such an approach is to have ILL staff search Google Scholar for full-text access to articles. Staff can then quickly look for links available in the right-hand column of the Google Scholar results page (Figure 9). When library access links are activated in Google Scholar, the results page also catches library-owned content, which is noted by the presence or absence of the library's link resolver, also in the right-hand column. Google could be added as a secondary search option, as long as it doesn't add confusion or excessively encumber staff time.

[place figure 9 here]

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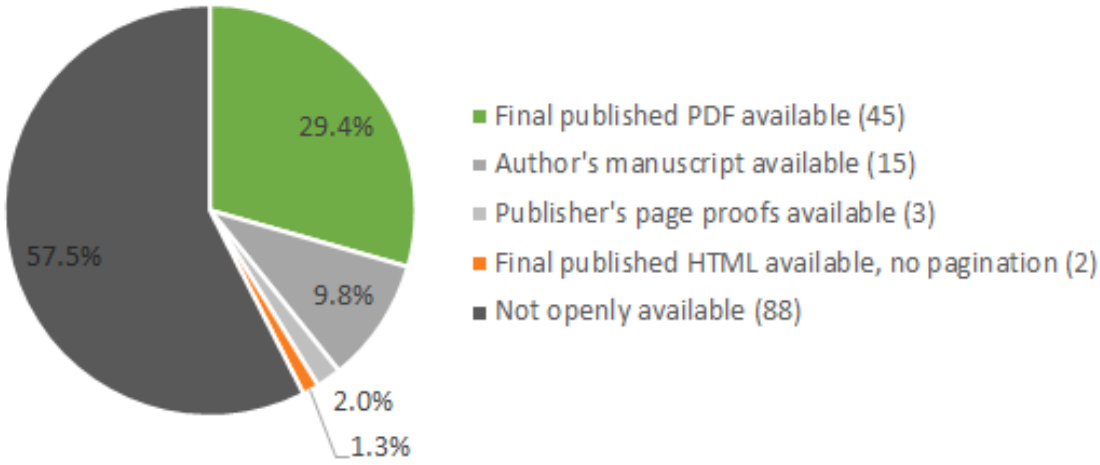

Figure 1. Online availability of ILL article requests (number of articles in parentheses). Only the final published PDF version meets local requirements for fulfilling ILL requests.

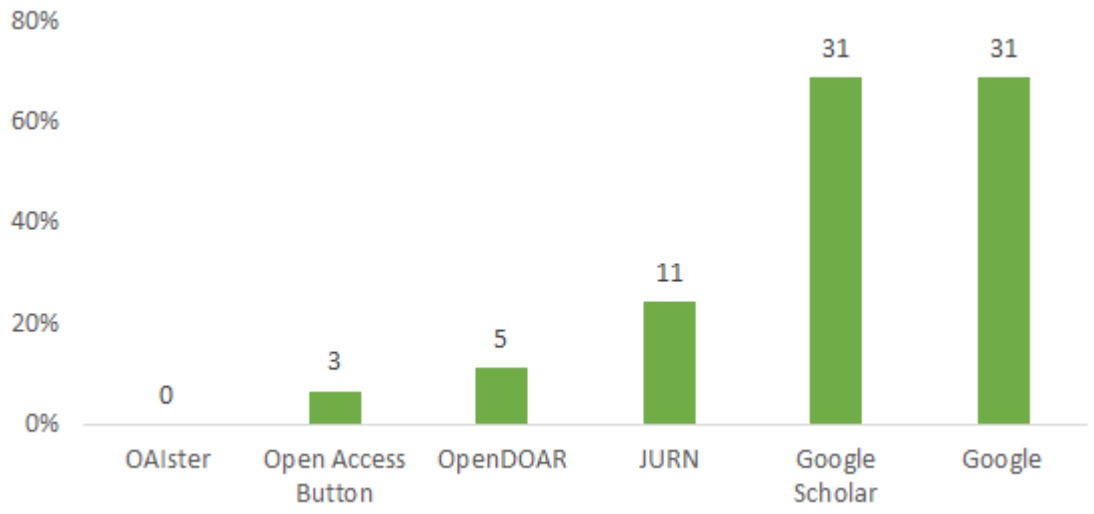

Figure 2. Freely available articles located by search tool (number of articles above each bar).

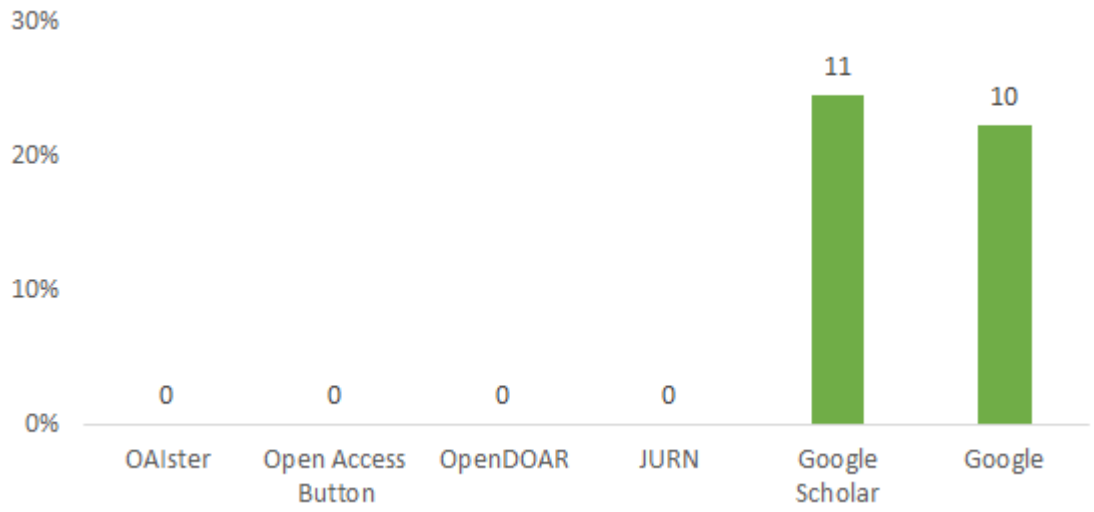

Figure 3. Freely available articles located uniquely by search tool (number of articles above each bar).

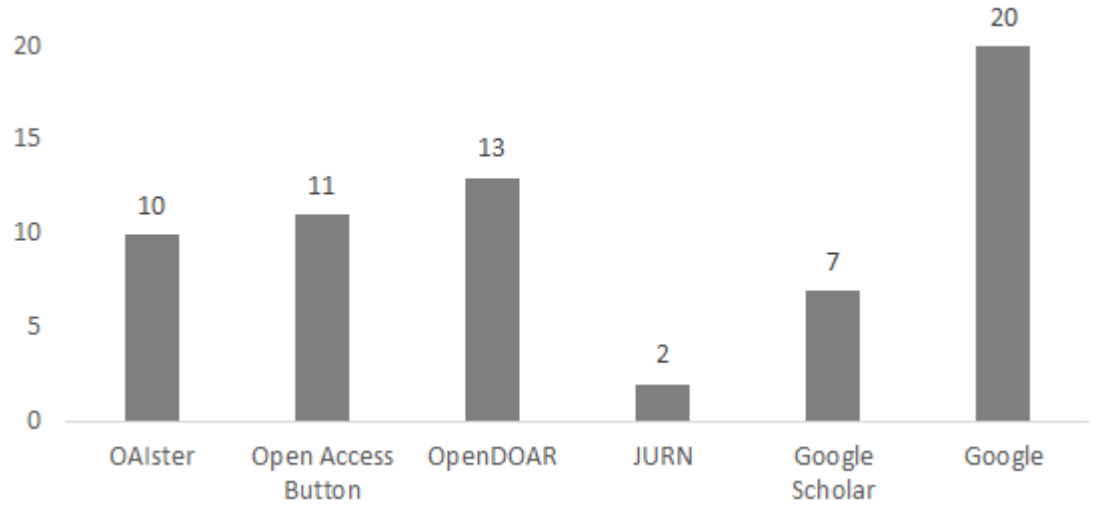

Figure 4. Number of false hits by search tool. False hits include false positives: links to the article abstract only, a paywall on a publisher's website, or a document similar to the article (e.g., a working paper, dissertation, or review of the article). False hits also include false negatives: not linking to a known OA article and, for Google only, links to full-text articles that were buried lower on results pages.

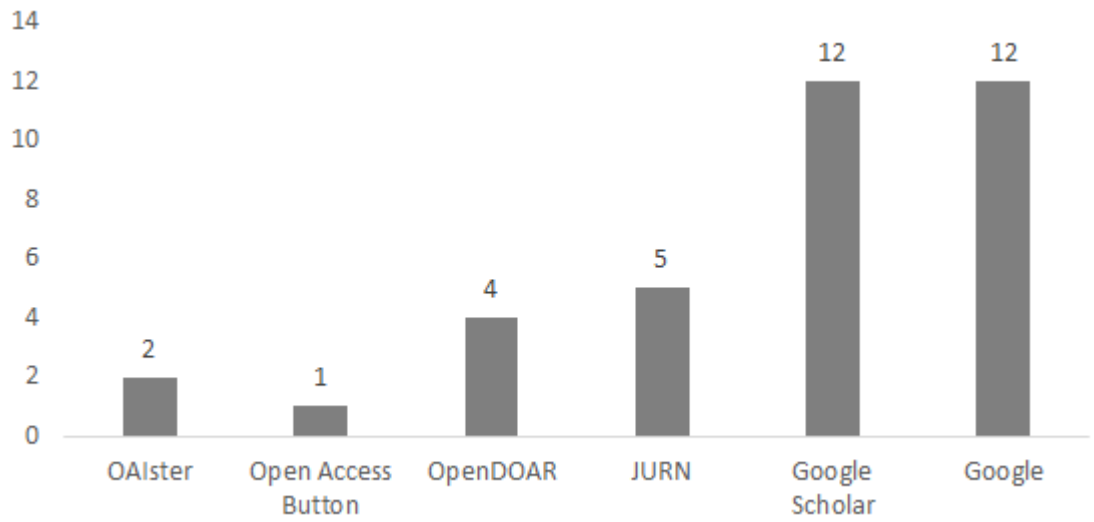

Figure 5. Number of pre-publications located by search tool. For the purpose of this study, pre-publications include both pre-prints and post-prints. Neither of these versions constitutes the version of record and cannot be used by a scholar to create an accurate citation. Pre-publications due not meet local requirements for fulfilling ILL requests.

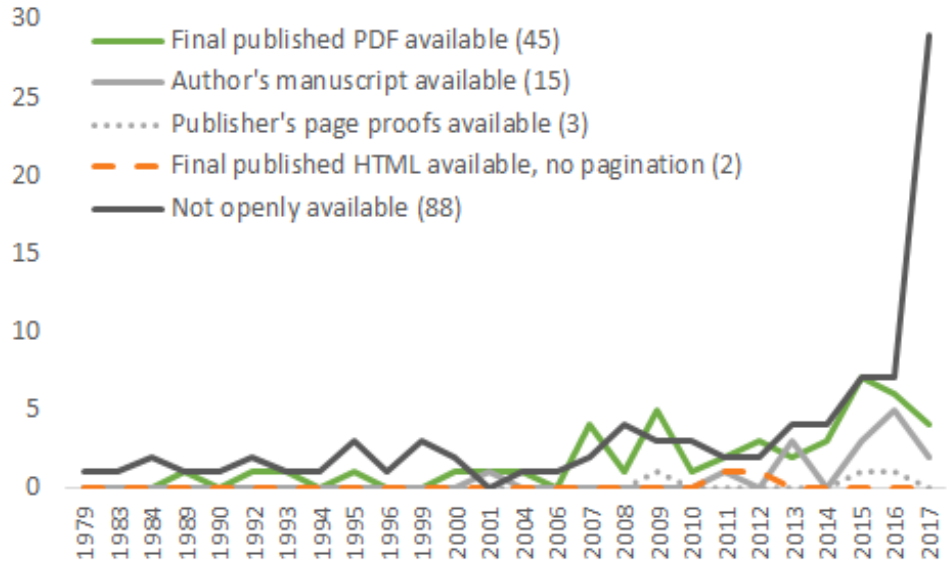

Figure 6. Article availability by publication year. Only the final published PDF version meets local requirements for fulfilling ILL requests.

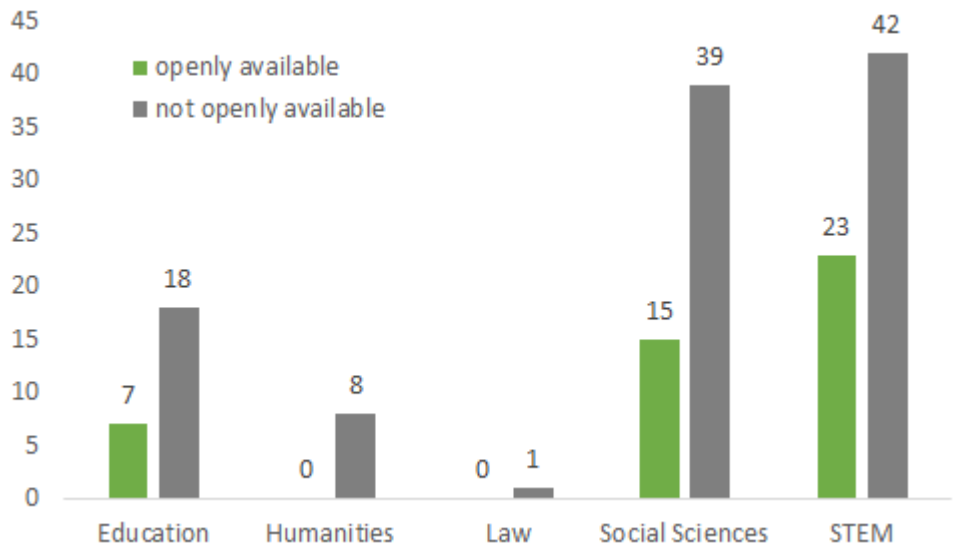

Figure 7. Number of openly available and not openly available articles by broad academic discipline. Openly available articles include only the final published PDF articles.

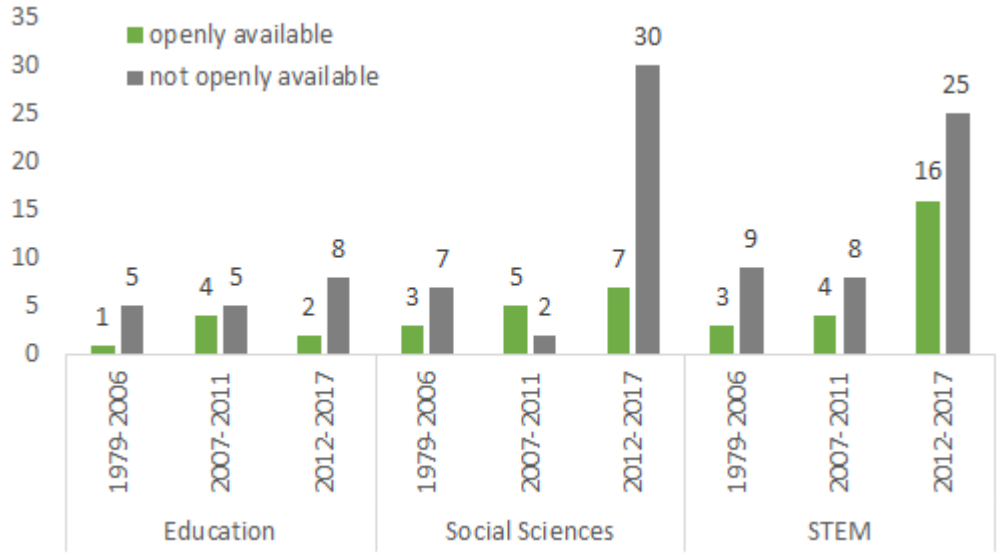

Figure 8. Availability of articles by discipline and publication year. Openly available articles include only the final published PDF articles.

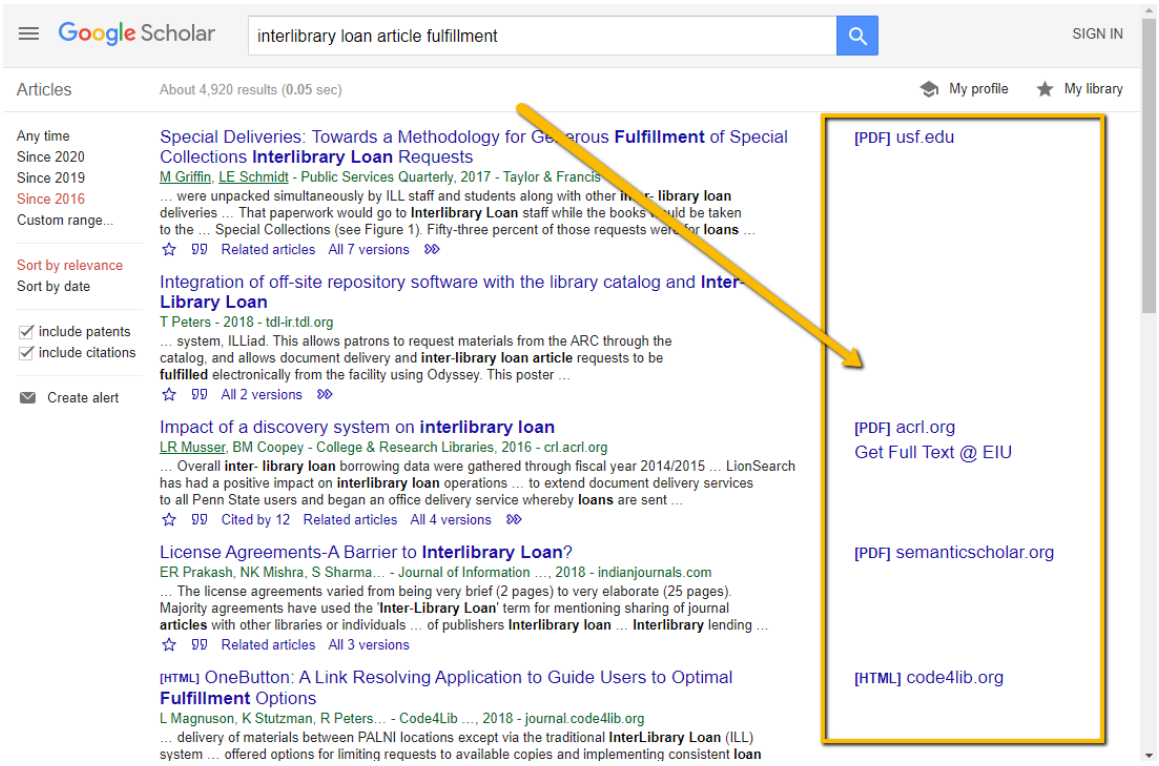

Figure 9. A Google Scholar results page clearly indicates which content is freely available, whether through a library subscription or through other means, by displaying a link to the content in the right-hand column. Items on the results page with no link in the right-hand column generally are not freely available.