Webometric analysis of alternative access to scholarly publication: Special reference to LibGen and Sci-Hub

Md. Liton Ali
Islamic University of Technology, Gazipur, Bangladesh

Article type
Research paper
Received
22 July 2023
Accepted
15 December 2023

International Journal of Information and Knowledge Studies, 3(1), pp. 85-102
ISSN 2789-5920
E-ISSN 2790-3265
https://doi.org/10.54857/ijiks.v3i1.68

Published by Bangladesh Institute for Information Literacy and Sustainable Development

Abstract

Purpose: This study aims to uncover the worldwide usage patterns and growth trends of Library Genesis (LibGen) and Sci-Hub, two popular alternative access platforms to scholarly publications.

Methodology: This study utilizes a webometric approach to analyze worldwide usage patterns and growth trends of LibGen and Sci-Hub. Data was collected between May and June 2023 on online presence, usage metrics, and patterns from different web-based tools like LibGen and Sci-Hub database, Google Trends, SimilarWeb, and existing Python and GitHub projects.

Findings: The study reveals that LibGen and Sci-Hub have experienced a notable surge in popularity despite facing copyright infringements, legal disputes, and restrictions. Conversion rates and unique visitors have significantly increased, with users from various nations, including developed countries like the USA and China. Statistical data shows a preference for accessing science and technology-related resources, particularly in the field of medicine.

Research limitations: The study acknowledges limitations related to potential discrepancies and biases from external software and incomplete representation of source databases.

Practical implications: The findings shed light on the challenges faced by the academic community and offer potential implications for policymakers, publishers, and researchers aiming to address the growing demand for affordable and accessible scholarly publications.

Originality/value: This research contributes to the existing knowledge domain by offering valuable insights into the extent and trends of utilizing shadow platforms, focusing on the implications of copyright infringements, legal concerns, and restrictions on scholarly knowledge dissemination.

Keywords: Scholarly publication, alternative information sources, resource access, LibGen, Sci-Hub, webometric.

1. Introduction

The advancement of the internet has steered into a new phase of scholarly communication, offering unprecedented opportunities for the dissemination and accessibility of academic research. However, traditional means of accessing scholarly publications, such as journal subscriptions and academic libraries, have faced significant challenges in cost and availability. In response, alternative platforms and shadow libraries like LibGen (Library Genesis) and Sci-Hub have emerged, providing researchers with cost free access to millions of scholarly articles that would otherwise be locked behind paywalls. Over the last two decades, LibGen and Sci-Hub emerged as significant disruptors in the scholarly publishing landscape, challenging the traditional academic publishing model, which heavily relies on expensive journal subscriptions. LibGen was established in 2008 and serves as a shadow library offering free access to a vast collection of books and scientific literature in convenient formats, while Sci-Hub, founded in 2011, utilizes proxy servers to bypass paywalls and retrieve research articles from subscription-based journals (Karaganis, 2018). These platforms have gained immense popularity due to their commitment to open access principles, addressing the barriers faced by researchers, students, academicians and knowledge seekers, particularly those from underprivileged institutions and developing countries. Moreover, these platforms facilitated access to over four-fifths of all scholarly articles, attracting a global user base, especially in countries with limited access to subscription-based journals (Himmelstein et al., 2018). During the last decade, the immense popularity of these shadow sources within the academic community underscores their significant impact on expanding access to scholarly literature. The widespread usage of shadow libraries has raised concerns among publishers and copyright holders, who argue that these platforms undermine the financial sustainability of the scholarly publishing system. Publishers contend that the unauthorized distribution of copyrighted content results in lost revenue and hampers investments in research and innovation. These debates have sparked discussions about the future of scholarly communication, the role of copyright laws, and the need for sustainable open-access models. Webometrics is a multidisciplinary field that examines various aspects of the web, including website content, structure, and link analysis, to understand and quantify the impact of web-based phenomena. In the context of scholarly communication, webometrics provides a valuable lens that can help to explore the influence and reach of alternative platforms like LibGen and Sci-Hub.

2. Literature review

Scientific articles serve as lifeblood in the global realm of academia and research especially for the students, professors, and researchers in various knowledge institutions but journal paywalls work in the opposite direction, making communication less open and efficient (Machin-Mastromatteo, Uribe-Tirado, & Romero-Ortiz, 2016). Elsevier was among the first publishers who emerged to cover operations costs and profit from sales of academic research, which became an industry, a 10 billion US dollar business

that grew from the process of scientific communication (Murphy, 2016). Criticism from librarians and researchers focuses on the commercial nature and rising expenses of scientific publishing, as prohibitive subscription costs of academic databases hinder knowledge institutions, including Harvard University Library, which, despite having the world's wealthiest budget, is facing challenges affording its approximately 3.5 million US dollars per year subscriptions (Sample, 2012). Sci-Hub was founded in 2011 by a young graduate student, Elbakyan, who, driven by frustration over high academic publishing costs, utilized her hacking abilities to gather login credentials from journal subscribers, mainly at universities, allowing her to access and redistribute vast amounts of academic literature (Harris & Barrett, 2019). Sci-Hub and LibGen known as the PirateBay of Academia, are popular platforms providing an elegant solution to bypass journal paywalls, granting access to millions of paywalled articles, disregarding copyright, with the general public, which funds academic research, being the ones most affected by paid access (Steel, 2016). Buehling, Geissler, & Strecker (2022) treat Sci-Hub as an exogenous event granting relatively unrestricted access to publications hidden behind a paywall and free access to academic knowledge, which will likely to improve the representation of authors from developing countries in international journals. The largest shadow libraries, LibGen and Sci-Hub, focusing on books and scholarly articles, were most likely developed in post-Soviet states, where covert, self-organized sharing of copied literature has a long tradition (Bodó, 2015). Both sources somewhat incorporate the content posted to social media platforms (Cabanac, 2016). Publish or perish has been the mantra for researchers and scientists over the decades and is regarded as an aphorism describing the sheer pressure to publish academic work in order to succeed in an academic career (Dhar et al., 2022). Resources from these alternatives are used by scientists not only from developing and underdeveloped countries, where access to subscription journals is difficult, but also from developed countries, where a quarter of the requests come from OECD countries (Organization for Economic Co-operation and Development), who have good access to subscription journals (Moskovkin, Gakhova, & Nabokov, 2021). According to Travis (2016), a good portion of the users found accessing full-text articles easier through Sci-Hub than through legal channels; over half of the researchers reported using Sci-Hub despite its disruptive impact on the publishing industry, with four-fifths considering it "not wrong" due to limited legal access and unjustified pricing of major commercial publishers. Despite the growth of Open Access, illegal access to scientific articles is becoming more widespread as scientists from underdeveloped countries, whose scientific organizations do not have money to access their content, receive illegal content (Bohannon, 2016). As stated by Moskovkin, Gakhova, & Nabokov (2021) the role of shadow libraries in the Open Access movement are like catalyst, speeding up the shift from commercial subscription models to open access as publishers adapt or fade away, allowing these pirate project to fizzle out naturally. In addition, Nicholas et al. (2019) found that a quarter of early career researchers (ECRs) are now using Sci-Hub, with French ECRs being the highest users, while ECRs from the UK, USA, Malaysia,

and China show little adoption due to reasons like legal restrictions and the presence of China's own equivalent platform. Sci-Hub is used both for convenience and necessity and its usage is not related to the quality of library services possessing a greater threat to publishers compared to ResearchGate (Schiermeier, 2017). Houle (2017a) found that a vast quantity of up-to-date full text content exits across disciplines even on the same day of publication. However, it may not cover Law, Music, and Business Management as comprehensively as other fields. Some publishers who were hesitant about having their content available through open-access discovery tools have either changed their stance over time or were compelled to do so due to mergers with other publishers with an opposite policy (Houle, 2017b). According to Greshake (2017), Sci-Hub serves various user groups, with a majority seeking access to recent publications, but some users, particularly engineers and chemists, rely on it for convenient access to historical academic literature due to the oligopoly nature of academic publishing in these fields. Sci-Hub was even nominated for the Free Knowledge Award by the Russian Wikimedia chapter (Sar, 2016). Singh, Srichandan, & Bhattacharya (2021) stated that the problem of access is endemic across disciplines, and it is faced by researchers at large and the choose alternative means to get access to scholarly publications. Thousands of articles are downloaded daily from these sources without differentiating between developing and developed countries, with around half of the downloads attributed to giant publishers like Elsevier (Bohannon, 2016). In the quest for updated knowledge and scientific advancements, researchers and students walk on an ethical tightrope by resorting to alternative sources to access plenty of scientific articles and information to enrich their daily practice (Bendezú-Quispe et al., 2016; Mejia et al., 2017). Furthermore, all the scientific literature is not available in one place, and some systems possess very old or new systems or have extreme security web protection, which leads to failure while downloading from the server (Mejia et al., 2017). Sci-Hub has emerged as the largest website to challenge publishers' models on a massive scale, allowing users to download articles, book chapters, monographs, or conference proceedings using just the document's title, Digital Object Identifier (DOI), PubMed identifier, or Uniform Resource Locator (URL) (McNutt, 2016). Additionally, Sci-Hub is not only a resource that contributes to research, but also aids in generating additional research (Resnick, 2016). Sci-Hub is widely used by students, particularly in poor countries without legal access to articles, with major download hotspots in academic centers in the United States and Europe, offering a faster and cost-effective alternative to online libraries, while free peer-reviewed science and medicine publications have also emerged to provide users with free content (Faust, 2016). Different multidisciplinary journals data indicated that articles downloaded from Sci-hub were cited 1.72 times more than the papers not downloaded from Sci-hub and that the number of downloads from Sci-hub was a robust predictor of future citations (Correa et al., 2020). Approximately one million medical journal articles are downloaded monthly through Sci-Hub, with demand spanning various income classifications, and the highest download densities occurring in middle-

income countries (Till et al., 2019). These shadow libraries have revolutionized access to scientific information, significantly impacting academic and research libraries, much like Napster did with music distribution, prompting uncertainty about the future and requiring a reevaluation of researchers' informational behavior (González-Solar & Fernández-Marcial, 2019). Adoption among certain individuals and locations appears to impact Inter Library Loan (ILL) usage, showing positive correlations with various library usage indicators and metrics related to students and the instructional population (Gardner, Mclaughlin, & Asher, 2017). Additionally, Hoy (2017) stated that the high cost of journal articles has led researchers to use "pirate" article sites like Sci-Hub, posing a major threat to traditional publishing models, while librarians should be mindful of its impact on patrons' expectations, potential risks, and copyright violations faced by these databases.

3. Objectives of the study

The main objective of this study is to investigate and compare the global trend of accessing scholarly content through alternative sources, Sci-Hub and LibGen. In order to obtain the main objective, some secondary objectives were formulated to guide the research investigation.

- Investigate the demographics of LibGen and Sci-Hub users, including their gender, age, country, and regional distribution.
- Assess the present status of the collection and access opportunities through LibGen and Sci-Hub.
- Identify the top regions, countries, and subject fields from where people are accessing content through LibGen and Sci-Hub.
- Examine the historical trend and growth rate of the Sci-Hub and LibGen over the years.
- Analyze the top sources users from diverse backgrounds utilize to download documents through LibGen and Sci-Hub.

4. Methodology

This research is conceptually based on information-seeking behavior theories, examining global trends and growth of alternative platforms like LibGen and Sci-Hub and how the adoption of these platforms spread across various user groups and locations. Furthermore, it focuses on the contribution of these platforms to the flow of information and the worldwide dissemination of academic knowledge. Webometric approaches were employed in this study to comprehensively analyze the worldwide usage patterns, growth trends, and user distribution of the two most popular shadow libraries, namely LibGen and Sci-Hub. Data collection for this research took place between May and June 2023 through a multifaceted approach based on web-based tools and databases. Data collection from these sources encompassed various parameters, including online

presence, usage metrics, distribution patterns, and other web-based analytics. The primary data sources comprised the LibGen and Sci-Hub databases. Google Trends data for the past year and the past five years were employed to analyze the popularity and relevance of these platforms over time which also offers valuable insights into their respective growth trends over the years. On the next phase, web data analytics for the period from April to June 2023 were carried out using SimilarWeb, which provided crucial information about the online activities and user engagement on these platforms. Additionally, Python projects like AceLewis facilitated data extraction through uTorrent and aided in the analysis related to Sci-Hub, providing insights into specific collection, subject coverage, and growth. Furthermore, available GitHub projects contributed as valuable resources to aid in the comprehensive data collection and analysis process. Finally, Data analyses were done to ensure the validity and reliability of the findings, incorporating statistical techniques and a previous literature review.

5. Results

Figure 1 depicts the gender distribution of visitors for Sci-Hub and LibGen. For Sci-Hub, male visitors constituted 50.97% and female visitors accounted for 49.03%. In the case of LibGen, male visitors comprised 52.66%, while female visitors represented 47.34%. The gender distribution suggests that both sources attract a relatively balanced proportion of male and female visitors. The small differences in percentages for each platform indicate that both resources are inclusive and appealing to a diverse audience.

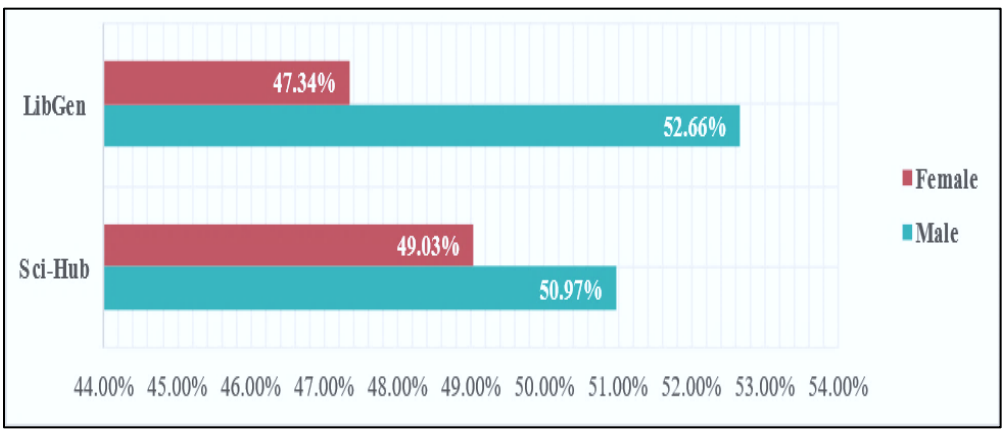

Figure 1: Gender distribution of Sci-Hub and LibGen visitors

5.1 Age group distribution of the sci-hub and libgen visitors

Figure 2 presents the age group distribution of visitors for Sci-Hub and LibGen. For Sci-Hub, the majority of visitors fall within the 25-34 years age group (33.99%), closely followed by the 18-24 years age group (29.75%). For LibGen, the highest percentage of visitors also falls in the 25-34 years age group (32.90%), with the 18-24 years age group at 28.42%. Both platforms seem to attract a significant number of users from these age brackets, making them popular choices among young adults.

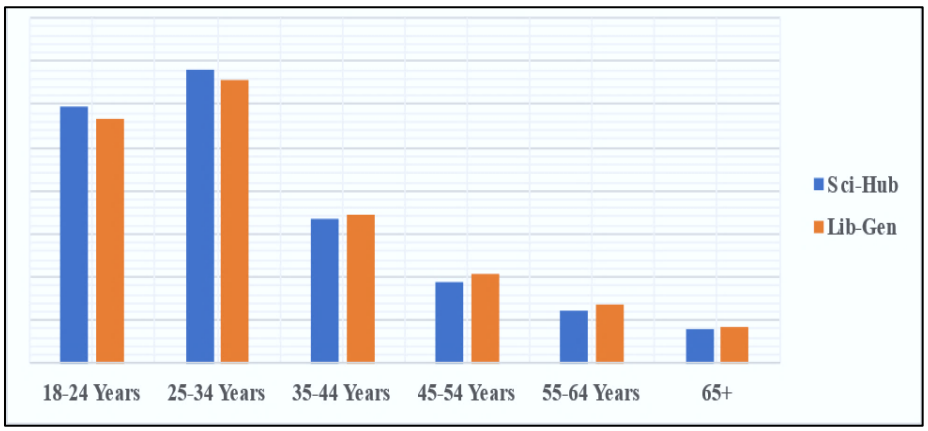

Figure 1: Age group distribution of the Sci-Hub and LibGen Visitors

5.2 Top countries with the most visitors

Table 1 reveals the top countries with the highest number of visitors for LibGen and Sci-Hub. For LibGen, the United States (USA) takes the lead with 14.33% usage, followed by Brazil at 9.97%, and India at 7.83%. In the case of Sci-Hub, India claims the top spot with 8.26% usage, while China ranks second with 7.26% usage. Notably, both platforms exhibit a global appeal, with visitors from various other countries constituting 57.3% for LibGen and 70.44% for Sci-Hub.

Table 1: Top countries with the most visitors

LibGen			Sci-Hub		
Rank	Country	Usage %	Rank	Country	Usage %
1	USA	14.33	1	India	8.26
2	Brazil	9.97	2	China	7.26
3	India	7.83	3	Indonesia	5.39
4	Turkey	6.33	4	Philippines	4.62
5	Canada	4.24	5	Brazil	4.04
	Other Countries	57.3		Other Countries	70.44

5.3 Collection status of libgen and sci-hub

Figure 3 shows that Sci-Hub database hosts 88 million research documents and is brimming with 100 terabytes of knowledge. Articles from journals comprise 80%, conferences 6%, and book chapters 5%. A significant 77% of content emerged between 1980 and 2020, with 36% published from 2010 to 2020. Virtually all major scientific publishers contribute to this wealth of information (>95% coverage). Twenty-five million medical articles lead the way, followed by chemistry, biology, humanities, and social sciences.

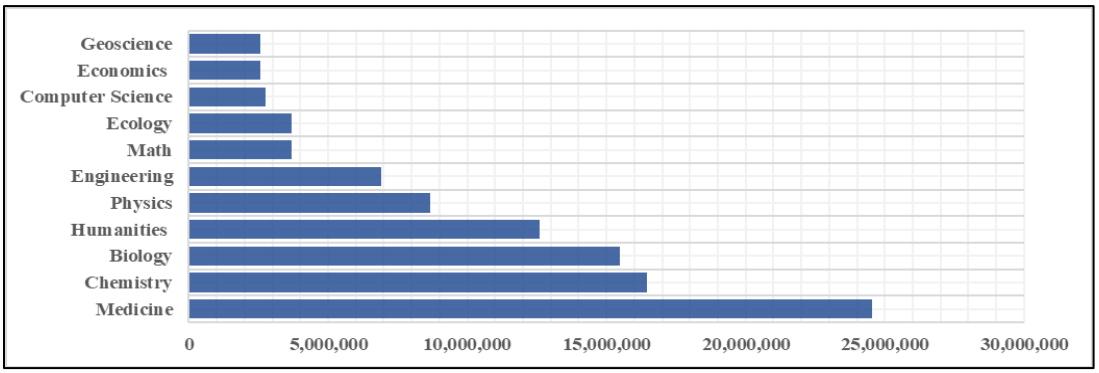

Figure 3: Collection status of Sci-Hub

On the other hand, LibGen is a treasure trove of knowledge with 2.4 million non-fiction books, 80 million science magazine articles, 2 million comics files, 2.2 million fiction books, and 0.4 million magazine issues. It offers a diverse range of topics, from history to science, economics to philosophy, serving as an invaluable resource for students, researchers, and curious minds.

Table 2: Documents status of LibGen

Documents Type	Documents Available
Non-Fiction Books	2.40 M
Science Magazine Articles	80.0 M
Comics Files	2.00 M
Fiction Books	2.20 M
Magazine Issues	0.40 M

5.4 Top 20 countries with the most downloaded documents

The download statistics from Sci-Hub show that China and the US lead in research paper downloads, with 46,209,122 and 15,790,876 respectively (Table 3). Surprisingly,

this pirated source attracts not only developing countries but also developed nations. Another interesting correlation has been shown between a country's population and its research paper downloads. With its massive population, China tops the chart with 46,209,122 articles downloaded, followed by the United States. This pattern suggests that countries with larger populations tend to have more researchers and academics seeking access to scholarly information even though it is not from actual sources.

Table 3: Top 20 countries with the most downloaded documents

Rank	Country	No. of articles	Rank	Country	No. of articles
1	China	46,209,122	11	New Zealand	798,434
2	United States	15,790,876	12	United Kingdom	795,523
3	Brazil	4,573,302	13	Singapore	775,179
4	India	2,840,026	14	Iran	771,840
5	Russia	1,958,988	15	Mexico	763,662
6	Indonesia	1,522,424	16	Netherlands	733,648
7	Germany	1,457,594	17	France	695,695
8	Canada	1,222,606	18	Malaysia	681,604
9	Australia	990,891	19	Argentina	640,821
10	Ireland	883,309	20	Japan	626,595

5.5 Most downloaded resources by subject field (05 years)

Over the years, the knowledge explosion resulted in substantial increase in scholarly publishing.

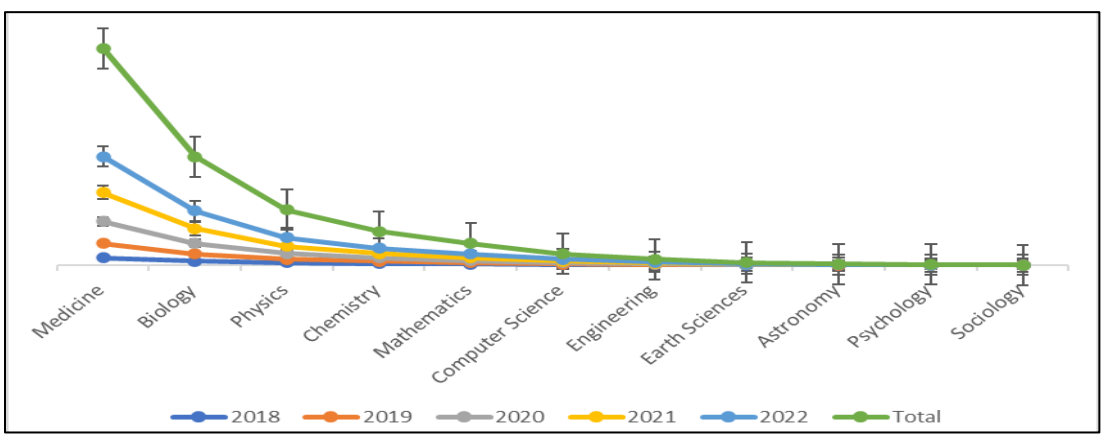

Figure 4: Most downloaded resources by subject fields

Medicine's publications soared, with an astonishing average growth of around one million articles annually. Biology, Physics, and Chemistry harmonized with substantial yearly increases, creating an enchanting symphony of progress. Meanwhile, Mathematics, Computer Science, and Engineering hummed at steady rates. Earth Sciences and Astronomy twinkled in celestial wonder, while Psychology and Sociology danced to their rhythms. Together, they formed a grand symphony of research, a testament to humanity's unyielding quest for understanding.

5.6 Usage comparison between sci-hub and libgen

In the world of shadow knowledge realms, it is witnessed that in medicine Sci-Hub takes the lead, offering a vast collection of valuable articles. Biology showcases a similar trend, with both platforms contributing to research pursuits. Physics, Chemistry, Mathematics, and Computer Science continue the harmonious symphony of knowledge as Sci-Hub and LibGen unite to provide a wealth of insights. From Earth Sciences to Psychology and Sociology, these extraordinary realms resonate with humanity's quest for understanding and discovery.

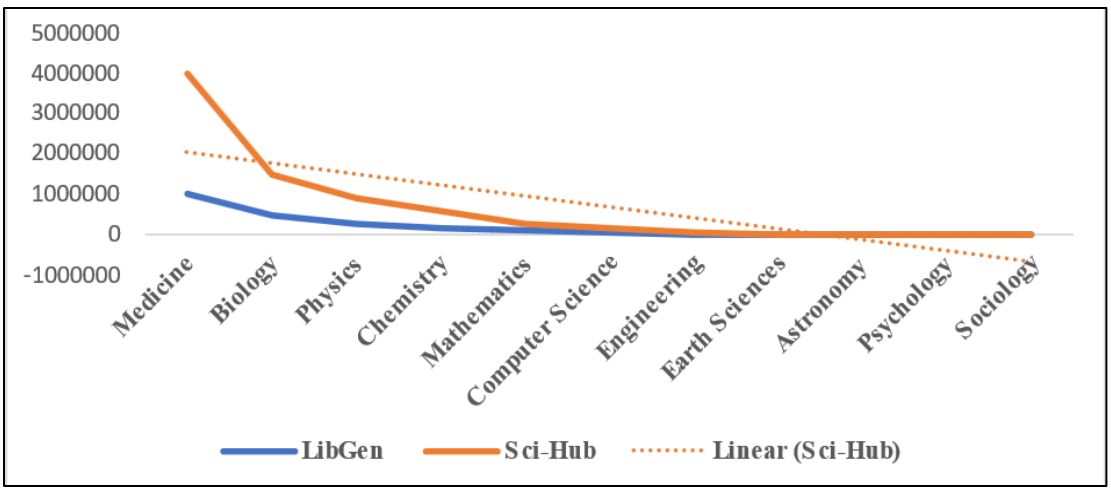

Figure 5: Usage comparison between Sci-Hub and LibGen

5.7 Article coverage from top 20 publishers

Table 4 unveils the open-access coverage of prominent publishers on Sci-Hub. Elsevier stays at top of the list with an impressive 96.9%, followed by Springer Nature 89.7%, and Taylor & Francis 92.6%. Wiley-Blackwell illuminates with 94.7%, while SAGE glows at 90.9%. The constellation continues with the Institute of Electrical and Electronics Engineers (IEEE) at 98.6%. However, a few wander differently; Bentham at 40.7% and Karger at 35.7%. Hindawi astounds with 85.7%, and Interperiodica Publishing dazzles at 97.2%. This stellar panorama paints a diverse and dynamic academic universe, welcoming seekers of knowledge with open arms. Study results indicate that

Sci-Hub also hosts and gives access to open-access journal papers with astounding coverage percentages.

Table 4: Article coverage from top 20 publishers

Rank	Publisher	Journals	Sci-Hub	Coverage	OA	Coverage
1.	Elsevier	3,410	13,115,639	96.9%	1.6%	91.0%
2.	Springer Nature	2,803	6,147,387	89.7%	7.0%	90.6%
3.	Taylor & Francis	2,710	3,000,211	92.6%	2.4%	90.2%
4.	Wiley-Blackwell	1,639	5,786,361	94.7%	1.6%	89.5%
5.	SAGE	816	1,448,041	90.9%	1.9%	97.7%
6.	Wolters Kluwer Health	426	1,481,291	79.4%	4.5%	96.7%
7.	Emerald	398	191,393	71.4%	0.0%	91.2%
8.	Walter de Gruyter	371	327,439	73.8%	5.9%	91.8%
9.	Cambridge Univ. Press	357	965,635	84.9%	0.1%	97.9%
10.	Oxford Univ. Press	316	1,567,250	88.3%	4.0%	98.5%
11.	IEEE	305	881,253	98.6%	0.5%	86.0%
12.	Inderscience	232	63,378	90.3%	0.0%	98.6%
13.	Bentham	231	34,981	40.7%	8.5%	93.1%
14.	Hindawi	223	63,655	41.9%	85.7%	93.6%
15.	Brill	189	150,537	85.0%	6.2%	93.7%
16.	Karger	156	119,263	35.7%	3.3%	92.3%
17.	Mary Ann Liebert	119	133,117	97.1%	0.2%	84.6%
18.	World Scientific	107	126,011	95.6%	0.7%	98.6%
19.	Thieme	101	311,523	71.5%	0.4%	89.6%
20.	Interperiodica Publishing	99	208,577	97.2%	0.0%	99.6%

5.8 Article coverage from top 20 journals

Table 5 depicts Sci-Hub coverage of esteemed journals. The Lancet takes the lead with 99.8%, Nature comes second with 96.6%, followed by Science with 91.9%, The Journal of the American Chemical Society with 99.8%. Some of them contain almost all the published papers like the New England Journal of Medicine with 99.9%, Physical Review Letters captivates at 99.8%, and Analytical Chemistry with 99.3%. However,

coverage of some journals is not high like Sci-Hub covers only 29.1 percent of the Lecture Notes in Computer Science. This panorama represents Sci-Hub as a celestial haven, unlocking the vast realm of knowledge across the scientific community.

Table 5: Article coverage from the top 20 journals

Rank	Journals	Articles	Coverage (%)
1.	The Lancet	457,650	99.8%
2.	Nature	385,619	96.6%
3.	Science	230,649	91.9%
4.	JAMA - Journal of the American Medical Association	191,950	77.3%
5.	Journal of the American Chemical Society	189,142	99.8%
6.	New England Journal of Medicine	180,321	99.9%
7.	Chemical and Engineering News	159,638	99.0%
8.	Advanced Materials Research	137,858	95.6%
9.	Journal of Applied Physics	128,777	96.0%
10.	Journal of Chemical Physics	125,968	96.2%
11.	Proceedings of the National Academy of Sciences	123,984	93.4%
12.	Physical Review Letters	118,570	99.8%
13.	Analytical Chemistry	116,072	99.3%
14.	Applied Physics Letters	115,148	97.6%
15.	Lecture Notes in Computer Science	103,675	29.1%
16.	Journal of Biological Chemistry	99,940	98.0%
17.	Tetrahedron Letters	98,482	99.5%
18.	Angewandte Chemie	95,845	97.7%
19.	Analytical and Bioanalytical Chemistry	95,631	99.9%
20.	American Journal of Nursing	93,348	95.5%

5.9 Searching trends of Sci-Hub and LibGen on Google

Figure 6 illustrates the search trend for Sci-Hub and LibGen on Google over the past five years which reveals a steady and consistent increase over time. Both platforms are gaining popularity among users for providing free access to academic, intellectual as well as literature related resources. This upward trajectory highlights the rising demand for

open-access knowledge and the significant role these platforms play over the years in catering to the information needs of researchers, scholars, and enthusiasts worldwide.

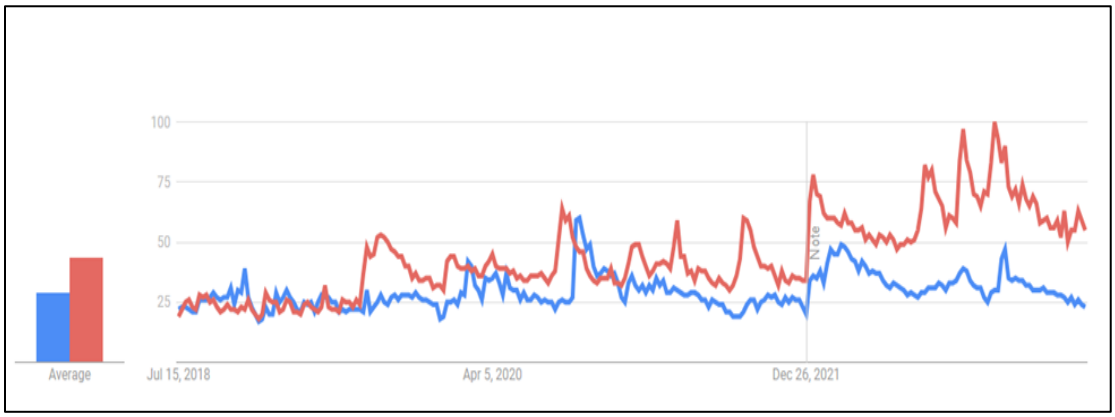

Figure 6: Searching trend of Sci-Hub and LibGen on Google

5.10 Global searching trend of Sci-Hub and LibGen on Google

Figure 7 shows Sci-Hub and LibGen's search trend is a captivating revelation of their global reach and popularity. Altough both platforms are popular worldwide, LibGen is more popular in the North America, South America, Asia, and Australia regions, captivating the minds of scholars and researchers on these continents. On the contrary, Sci-Hub popularity shines more in Russia, China, and various other countries, emphasizing the profound impact in democratizing access to knowledge across the world.

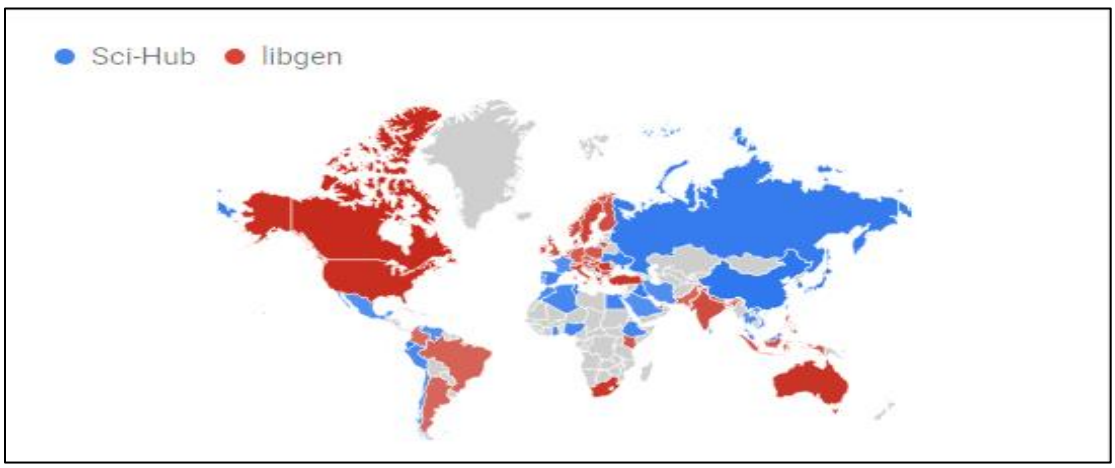

Figure 7: Global searching trend of Sci-Hub and LibGen on Google

5.11 Last three months visitor analysis of Sci-Hub and LibGen

Figure 8 shows visitor analysis for Sci-Hub and LibGen between April to June 2023. During April, Sci-Hub received around 13.7 million visits, while LibGen recorded 14.6 million website visits. As May bloomed, Sci-Hub surpassed 14.9 million visits and LibGen had more than 15 million visits. However, in June visitor declines in both platform where Sci-Hub received 14.1 million aligned with LibGen's 14 million. Overall, both platforms received around fourteen to fifteen million website hits each month.

Figure 8: Month-by-month visitor data analysis of Sci-Hub and LibGen

5.12 Web data analytics of June 2023

Table 6 presents visitor statistics for Sci-Hub and LibGen of June 2023. Results show Sci-Hub recorded 14.1 million total visits with a bounce rate of 31.36%. Visitors spent an average of 4.34 pages per visit and stayed on the platform for approximately 6.06 minutes. LibGen recorded around 14.0 million visits, with a 21.0% bounce rate. Visitors explored an impressive 7.69 pages per visit and spent around 5.29 minutes showcasing its appeal and user engagement. LibGen possesses around a 10 percent lower bounce rate than Sci-Hub.

Table 6: Web data analytics of June 2023

Sources	Total Visits	Bounce Rate	Pages per Visit	Avg. Visit Duration
Sci-Hub	14.1M	31.36%	4.34	06.06 min
Lib-Gen	14.0 M	21.0 %	7.69	05.29 min

6. Discussion

Sci-Hub and LibGen, two shadow libraries, offer free access to plenty of scientific literature from diverse disciplines. Previously, it was found that the use of Sci-Hub had a significant impact on the publishing activity in developing countries and had a positive effect on article citations. Furthermore, it was discovered that Sci-Hub provided access to nearly all scholarly literature with usage data from Latin America indicating a high rate of piracy and most researchers gave a thumbs up to pirated papers (Mejia et al., 2017). In addition to previous studies, this webometric investigation illustrates that the gender distribution of visitors to both Sci-Hub and LibGen was relatively balanced, with male visitors accounting for approximately 50-53% of the total visitors. Visitor age groups were also similar for both sources, with most visitors falling within the 25-34 years age group. Both platforms were found to have a global appeal including underdeveloped, developing, and even developed countries like the USA, China, Germany, Australia and more. Sci-Hub database hosts more than 88 million research documents, while LibGen contains 2.4 million non-fiction books, 80 million science magazine articles, and more. Both of the platforms offer access to a wide range of scholarly contents regardless of disciplines, especially have higher usage in medicine, biology, and technology. Article coverage from most of the top publishers and journals were found to be high on Sci-Hub, with Elsevier leading the chart at 96.9% coverage. Study also reveals that these platforms also host open access scholarly articles even though these are accessible through the original sources. The global search trend on google and website usage of both platforms have steadily increased over the years having millions of visits per months with a good bounce rate and average page visits.

7. Conclusion and future research directions

Despite the growing popularity of the open-access movement, accessing research publications still becomes a big challenge for researchers from diverse backgrounds. Due to heightened security measures implemented by publishers and the imposition of various country-specific restrictions, access to recent publications, especially those published beyond 2021 has become challenging on platforms like Sc-Hub and LibGen. This situation may lead to a potential decrease in research contributions from underdeveloped and developing countries, as they lack access to genuine sources. Sc-Hub and LibGen are not only faces issues while providing access to recent publications, but also require maintain several mirror servers and to change the servers IPs often to mitigate country specific restrictions. Consequently, future studies could explore the impact of these accessibility issues on scholarly contributions from these regions and assess the citation rate of recent publications to understand how barriers to document downloads from these shadow libraries have influenced overall citation rates. Future quantitative and qualitative studies on the user perspectives and comparison of accessing documents from the original sources and alternative sources could shed light on the development of user centric platforms and models. However, encouraging the Open

Access movement and addressing access-related challenges require collaboration among publishers, researchers, and policymakers to ensure equitable access to knowledge and foster a culture of collaboration and innovation in academia regardless of geographic or financial constraints.

References

1. Bendezú-Quispe, G., Nieto-Gutiérrez, W., Pacheco-Mendoza, J., & Taype-Rondan, A. (2016). Sci-Hub and medical practice: An ethical dilemma in Peru. *The Lancet Global Health*, *4*(9). doi:10.1016/S2214-109X(16)30188-7
2. Bodó, B. (2015). Libraries in the Post-Scarcity Era. In H. Porsdam (Ed.), *Copyrighting Creativity Creative Values, Cultural Heritage Institutions and Systems of Intellectual Property*. London: Routledge. https://doi.org/10.4324/9781315574257
3. Bohannon, J. (2016). Who's downloading pirated papers? Everyone. *Science*, *352*(6285), 508–512. doi:10.1126/science.352.6285.508
4. Buehling, K., Geissler, M., & Strecker, D. (2022). Free access to scientific literature and its influence on the publishing activity in developing countries: The effect of Sci-Hub in the field of mathematics. *Journal of the Association for Information Science and Technology*, *73*(9), 1336–1355. doi:10.1002/asi.24636
5. Cabanac, G. (2016). Bibliogifts in LibGen? A study of a text-sharing platform driven by biblioleaks and crowdsourcing. *Journal of the American Society for Information Science and Technology*, *67*(4), 874–884. doi:10.1002/asi.23445
6. Correa, J. C., Laverde-Rojas, H., Marmolejo-Ramos, F., Tejada, J., & Bahník, Š. (2020). The Sci-hub Effect: Sci-hub downloads lead to more article citations. *arXiv preprint*. http://arxiv.org/abs/2006.14979
7. Dhar, R., Talukdar, J., Kumar, A., & Karmakar, S. (2022). The problem with APC and open access: Hurdles in publishing practice. *Asian Journal of Medical Sciences*, *13*(3), 1–2. doi:10.3126/ajms.v13i3.43090
8. Faust, J. S. (2016). Sci-Hub: A solution to the problem of paywalls, or merely a diagnosis of a broken system? *Annals of Emergency Medicine*, *68*(1), A15–A17. doi:10.1016/j.annemergmed.2016.05.010
9. Gardner, G. J., Mclaughlin, S. R., & Asher, A. D. (2017, March). *Shadow libraries and you: Sci-Hub usage and the future of ILL*. Paper presented at the ACRL 18th National Conference, "At the Helm," Baltimore, MD, United States. http://hdl.handle.net/11213/17772
10. González-Solar, L., & Fernández-Marcial, V. (2019). Sci-hub, a challenge for academic and research libraries. *Profesional de La Informacion*, *28*(1), 1–12. doi:10.3145/epi.2019.ene.12
11. Greshake, B. (2017). Looking into pandora's box: The content of Sci-Hub and its usage. *F1000Research*, *6*(5), 1–14. doi:10.12688/f1000research.11366.1
12. Harris, S., & Barrett, D. (2019). Justice department investigates Sci-Hub founder on suspicion of working for Russian intelligence. *Washington Post*, 1–8. https://www.researchgate.net/profile/Hassan_Zargar2/post/Justice_Department_investigates_Sci-

Hub_founder_on_suspicion_of_working_for_Russian_intelligence/attachment/5e3536d7cfe4a79f3e7d165f/AS%3A853684908990465%401580545751855/download/Justice+Department+

13. Himmelstein, D. S., Romero, A. R., Levernier, J. G., Munro, T. A., McLaughlin, S. R., Greshake Tzovaras, B., & Greene, C. S. (2018). Sci-Hub provides access to nearly all scholarly literature. *ELife*, *7*, 1–22. doi:10.7554/eLife.32822
14. Houle, L. (2017a). Google scholar, Sci-Hub and LibGen: Could they be our new partners? *Proceedings of the IATUL Conferences*, Paper 3. http://docs.lib.purdue.edu/iatul/2017/partnership/3
15. Houle, L. (2017b, August). *Sci-Hub and LibGen: what if… why not.* Paper presented at the Satellite Meeting: Serials and Other Continuing Resources Section & Acquisition and Collection Development, European Solidarity Center (ESC), Gdańsk. doi:10.5061/dryad.q447c
16. Hoy, M. B. (2017). Sci-Hub: What librarians should know and do about article piracy. *Medical Reference Services Quarterly*, *36*(1), 73–78. doi:10.1080/02763869.2017.1259918
17. Karaganis, J. (2018). *Shadow libraries: Access to knowledge in global higher education.* Cambridge, MA: The MIT Press.
18. Machin-Mastromatteo, J. D., Uribe-Tirado, A., & Romero-Ortiz, M. E. (2016). Piracy of scientific papers in Latin America: An analysis of Sci-Hub usage data. *Information Development*, *32*(5), 1806–1814. doi:10.1177/0266666916671080
19. McNutt, M. (2016). My love-hate of sci-hub. *Science*, *352*(6285), 497. doi:10.1126/science.aaf9419
20. Mejia, C. R., Valladares-Garrido, M. J., Miñan-Tapia, A., Serrano, F. T., Tobler-Gómez, L. E., Pereda-Castro, W., Mendoza-Flores, C. R., Mundaca-Manay, M. Y., & Valladares-Garrido, D. (2017). Use, knowledge, and perception of the scientific contribution of Sci-Hub in medical students: Study in six countries in Latin America. *PLoS ONE*, *12*(10), 1–9. doi:10.1371/journal.pone.0185673
21. Moskovkin, V. M., Gakhova, N. N., & Nabokov, A. Y. (2021). Downloading articles by Russian researchers using the Sci-Hub resource. *Scientific and Technical Information Processing*, *48*(3), 159–167. doi:10.3103/S0147688221030059
22. Murphy, K. (2016, March 12). Should all research papers be Free? *New York Times.* https://www.nytimes.com/2016/03/13/opinion/sunday/should-all-research-papers-be-free.html
23. Nicholas, D., Boukacem-Zeghmouri, C., Xu, J., Herman, E., Clark, D., Abrizah, A., Rodríguez-Bravo, B., & Świgoń, M. (2019). Sci-Hub: The new and ultimate disruptor? View from the front. *Learned Publishing*, *32*(2), 147–153. doi:10.1002/leap.1206
24. Resnick, B. (2016, April 28). Why one woman stole 47 million academic papers and made them all free to read. *Science.* http://www.vox.com/2016/2/17/11024334/sci-hub-free-academic-papers
25. Sample, I. (2012, April 24). Harvard university says it can't afford journal publishers' prices. *The Guardian*, 2–5. http://www.theguardian.com/science/2012/apr/24/harvard-university-journal-publishers-prices
26. Sar, E. Van der. (2016, April). RuTracker and Sci-Hub nominated for free knowledge award. *Torrent Freak.* https://torrentfreak.com/rutracker-and-sci-hub-nominated-for-free-knowledge-award-160423/

27. Schiermeier, Q. (2017). US court grants Elsevier millions in damages from Sci-Hub. *Nature*.doi:10.1038/nature.2017.22196
28. Singh, V. K., Srichandan, S. S., & Bhattacharya, S. (2021). What do Indian researchers download from sci-hub? An analytical introspection. *Journal of Scientometric Research*, *10*(2), 259–264. doi:10.5530/JSCIRES.10.2.40
29. Steel, G. (2016). Some thoughts about Sci-Hub. *The Winnower*, *February*, 17–19. doi:10.15200/winn.145580.05844
30. Till, B. M., Rudolfson, N., Saluja, S., Gnanaraj, J., Samad, L., Ljungman, D., & Shrime, M. (2019). Who is pirating medical literature? A bibliometric review of 28 million Sci-Hub downloads. *The Lancet Global Health*, *7*(1), e30–e31. doi: 10.1016/S2214-109X(18)30388-7
31. Travis, J. (2016, May 6). In survey, most give thumbs-up to pirated papers. *Science*, 1–16. http://www.sciencemag.org/news/2016/05/survey-most-give-thumbs-pirated-papers

Author biography

Md. Liton Ali is an Assistant Cataloguer at the Library and Documentation Office of the Islamic University of Technology in Gazipur, Bangladesh. He holds Bachelor and Postgraduate degrees in Information Science and Library Management from the University of Dhaka. Mr. Ali has received multiple awards and scholarships for his academic achievements, including the Gold Medal, Deans Award, Provost Award, and various prestigious scholarships. Throughout his university years, he served as a Teaching Assistant and actively participated in cultural and co-curricular activities. Alongside his study, Mr. Ali has gained extensive experience in organizational automation and digitization, having worked on over twelve (12) library automation projects and completed two (02) internships. He has also actively participated and volunteered in numerous national and international webinars, seminars, conferences, and symposiums.

Corresponding author

Md. Liton Ali can be contacted at: litonali@iut-dhaka.edu