Pastor-Ramon E. Sci-Hub use among Spanish researchers : Enemy or a learning opportunity for libraries? J Inf Sci. 2023. https://doi.org/10.1177/01655515221142432

Abstract

Access to scientific literature is the cornerstone of scientific knowledge and numerous scientific-technical and social advances. However, in 2018, major difficulties in accessing the scientific literature have been reported. Despite Open Access has made more than 50% of scientific literature accessible without paywalls, during this year's access to pirate scientific resources, such as Sci-Hub, has increased. It is one of the most popular resources among researchers and university students. The key aspect is to differentiate between these kinds of resources (black open access or shadow library) and the Open Access movement. Black open access violates copyright regulations, and Open Access wants to give authors control over the integrity of their work and the right to be properly acknowledged and cited. We conducted a questionnaire with 17 items about the use of Sci-Hub among Spanish-speaking sciences and social sciences researchers. Libraries must learn from these kinds of resources how to improve the access to their scientific resources, and propose to the editors a different way of business, more similar to Spotify or Netflix than the journal bundles offered nowadays, usually with numerous journals with an embargo period or no relevance to the scientific community.

Aims and background

This study wants to analyze the use and knowledge that researchers have about their libraries as research support services. In addition, we wanted to explore the use and reasons for the use of the black library known as Sci-Hub.

Access to scientific literature is the cornerstone of scientific knowledge and numerous scientific-technical and social advances[1]. However, in 2018 it was estimated that there were difficulties in accessing 75% of the scientific literature generated [2]. Initiatives such as Open Access (OA) have made approximately 50% of the scientific output accessible without paywalls [3]. Despite this, there are still access barriers to scientific literature, therefore it is easily understandable that this inequality of access has served as a trigger for the emergence of "alternative" forms of access that can be encompassed in the black or *guerrilla* open access[4,5].

Although the exact coverage of Sci-Hub is unknown and varies between disciplines, studies suggest that it outperforms Green open access and provides access to "68.9% of the 81.6 million scholarly articles registered with Crossref and 85.1% of articles published in toll access journals" [6].

Attempting to access scientific publications using someone else's credentials is not new, piracy exists ever since global access to the internet was available. In the early 2000s, a list posted on a Korean website was passed from hand to hand, giving access to different providers through personal credentials. It was a widely used resource, but nobody talked about it openly; the debate was generated after its closure, even the librarians themselves regretted that they would not have access to many journals [4,7].

The so-called Shadow Libraries [8] are not a new phenomenon. Some examples of these are Library Genesis, LibGen, and Sci-Hub, emerging in response to complex political, social and, especially, economic situations that affected the limitation of access to knowledge [9].

Sci-Hub, created by Alexandra Elbakyan in 2011, due to the lack of access to the information she needed for her thesis, is one of the most popular resources among researchers and university students. Despite the existing literature, we still lack concrete data to know how these kinds of tools affect the profits made by publishers and whether they influence in some way the use of libraries and the reduction of services such as inter-library loans [10]. Most empirical studies on Sci-Hub have been based on data published by Bohannon in 2016 [11–13,13,14].

Sci-Hub has been labelled in different ways, depending on the point of view adopted: pirate OA, black OA [15,16], illegal OA, shadow library [8,10,17], 'rogue' OA or 'Robin Hood' OA [1], *guerrilla* OA (term used by hacktivist and Reddit co-founder Aaron Swartz). The term varies depending on whether the emphasis is placed on infringing copyright or the act of civil disobedience [18]. Studies on the scope of OA do not include Sci-Hub, since they do not consider it a type of OA [3].

The key aspect to differentiate between black OA and OA is the copyright. Black OA violates copyright regulations. It does not take into account whether the content is copyrighted or whether there is some kind of license restricting its access and distribution. OA, however, refers to its free availability on the public Internet, allowing them to read, download, copy, distribute, print, searched, or link to full text, crawled for indexing, incorporate them as data in software, or use for any other lawful purpose, with no financial, legal, or technical barriers other than those inseparable from Internet access itself. OA advocates that the only limitation to reproduction and distribution, and the only role of copyright (economic rights) in this area, is to give authors control over the integrity of their work and the right to be properly acknowledged and cited [19].

Different systems allow access to the full text at the limit of legality, although access is not always immediate: you can send an email to the authors or resort to Twitter, using the hashtag #IcanhazPDF or groups such as ‘Bajame este paper’ (Download this paper) from Facebook.

So, what difference do we find in Sci-Hub? Its strength is its access system, full-text is accessed in five steps, while in a library it can take up to ten in opinion of James Heathers [20]. Apart from the ease of use and access, another palpable difference is the dimension Sci-Hub reaches. Practices such as requesting the full text from the author, the hashtag #IcanhazPDF or requests to Facebook groups, are individual and specific requests. Sci-Hub, however, also allows large-scale automatic downloading of millions of scientific articles [21].

Literature review

In the bibliography, we find different cases, but always similar, of PhD students or researchers facing limitations of access at their university to the content they need to elaborate their research [18,19,21,22]. Sci-Hub itself started in 2011 as a result of Alexandra Elbakyan's inability to find the full text of the articles she needed for her research. She created a script that circumvented the barriers of paywalled academic journals [23]. When an

article is requested from Sci-Hub, it first searches for it in LibGen (2021) and, if not found, obtains the article from some subscribing institution by fraudulently using the subscribing institution's credentials, saving a copy in LibGen for later uses [24].

According to Elbakyan, researchers are the ones who provide Sci-Hub with their own credentials, and no phishing or hacking is taking place [21,25]. Some authors doubt this statement and do consider that copyright is being violated and by having the users' personal credentials, a theft of their digital identity is indeed taking place. In some cases, they speak of credential theft through phishing [24,25].

Based on the theoretical proposals above, the aim of the present study was to explore, in Spanish research and academic institutions, the access to scientific manuscripts, the access to scientific manuscripts through institutional or not institutional access, and the reasons to access through non-legal resources like Sci-Hub.

Material and methods

Study design, participants, and setting

The study had an observational descriptive cross-sectional design, that elicited researchers' perceptions of accessibility and the resources, institutional and non-institutional used to access the scientific information.

Participants in the study were Spanish-speaking sciences and social sciences researchers, recruited with convenience sampling methods carried out on social media (Twitter, Facebook, and LinkedIn). The inclusion criteria were: (i) researchers on science and social sciences, (ii) researchers on duty and actively working, (iii) researchers with activity in the public or private institutions with research activity as universities, hospitals, research centers, etc.

The instrument to acquire sociodemographic data was an ad hoc questionnaire designed with the collaboration of researchers and librarians, key players in this analysis due the role that sometimes they play as a enemies instead of collaborators because reserchers cannot access to all the information that they need, and librarians see how researchers undervalue their fight against editors to have the information their users need. So, the final questionnaire had 17 items, developed with google forms, divided into three main sections: i) sociodemographic section, ii) information on their profession and job, iii) resources to bibliographic search (table 1). The survey included 15 closed and 2 open-ended questions. We pretested the survey and estimated that participants could fill it out in a time estimate of 5 minutes. This questionnaire was shared for all the authors using their personal Twitter, Facebook, and LinkedIn accounts.

Table 1. Survey

Question	Options
Age	
Sex	Women, men, others.
Academic degree	Ph.D., Master, graduate, undergraduate
Location	Spanish's Autonomous communities

Knowledge area	Science, health sciences, or social science
Experience (years)	0-1, 2-5, 6-10, 11-20, +21
Centre of activity	University (public or private), Hospital (public or private), Research center (public or private)
Your place of work/study facilitates access to academic literature?	Yes, No, I don't know
What kind of options do you have to access the scientific information?	From the library itself, through online resources, I don't know because I never use them.
How often do you use the library to request scientific information to support your research?	Always, frequently, sporadically, never.
Could you indicate the barrier and/or limitation that you find for the use of the library?	Unknowdlege of the offered services, lack of time to go there, no remote access to the documents, the library do not offer the service needed, they take too long in giving the service.
Which of the external resources do you use to get scientific articles?	databases specific to my area of expertise, general academic searchers (google scholar), No official resources
If you use no official resources, from where do you access them?	I access it through my working network. Outside my place of work. I do not have access to this kind of service.
Do you know what is Sci-Hub?	Yes, legal access to the articles. Yes, no legal access to the article. I do not know.
Can you define briefly what Sci-Hub is?	
Do you use Sci-Hub as an external resource to have scientific documents?	I always use it, it is my first option. I use it frequently. I use it sporadically when I do not have another way to access it. Never.
Could you indicate the reasons that lead you to use Sci-Hub as opposed to other means of obtaining scientific papers?	Quick access and easy. If the document is not available in the library. Economic reasons (no access to the journal). Without library to where request articles. Others, and easy access.

Data collection procedure

Data collection began on September 28 2021 and ended on October 28, 2021. The response rate was high the first week, but after two weeks decreased. The survey was implemented as a CAWI (Computer Aided Web Interviewing) interview, and was distributed on social media. The questionnaire took an estimated 5 min to complete.

For data analysis, descriptive and inferential statistics were used via the Statistical Package for the Social Sciences software (SPSS) version 23.0 (IBM, Armonk, NY, USA). First, to identify the relationships between variables, correlational and descriptive analyses were carried out. The statistical level of significance is set at $p < 0.05$.

Ethical considerations

The research proposal was previously evaluated and approved by the Ethical Research Committee of the Universidad Alfonso X el Sabio, Madrid, Spain. Participation was voluntary and before starting to answer the questionnaire, essential information about the study was provided, as well as questions about the management and processing of personal data. Subjects gave their consent by ticking a box designated for this purpose, the validation of which gave access to the questionnaire.

Results

Sample Characteristics

Our final sample consisted of 182 researchers, where the mean age was 41.56(SD=9.89)years, and 53.6% were women.

For their maximum academic degree, it was observed that 49.2% (90) of the participants had a Ph.D. degree, followed by those with a master's degree, who accounted for 30.1% (55) (table 1). It was also observed that most of the participants worked in the area of Health Sciences (63.2%) and the majority of the experience in their jobs was between 11-20 years (35.7%), followed by more than 21 years (34.1%) (Table 1).

On the other hand, with regard to the workplace where the participants carried out their professional and research activities, it was found that they carried out their activity in public institutions (91.2%) compared to 8.8% who did so in privately owned centres. We observed that the most participants carry out their activities in public universities (50.5%) followed by public hospitals (27.5%).

Table 2. Sociodemographic description of the sample.

Variables	n	%
Sex		
Female	96	52.7
Male	83	45.6
Prefer not to answer	3	1.6
Academic degree		
Graduate	37	19.3
Máster	55	30.2
PhD	90	49.5.
Area of Knowledge		
Science	24	13.2
Health Sciences	115	63.2
Social Sciences	43	23.6

Experience in current position (years)		
0-1	6	3.3
2-5	25	13.7
6-10	24	13.2
11-20	65	35.7
>21	62	34.1
Workplace		
Public University	92	50.5
Private University	14	7.7
Public Hospital	50	27.5
Research institute (public)	24	13.2
Research institute (private)	2	1.1

Use of resources for access to scientific information

The analysis of the accessibility of the library and the resources offered for accessing scientific literature in the centres where the participants carry out their research activities indicated that 86.3% (n=157) participants were aware that their centres offer facilities for accessing scientific literature. However, only 39.6% (n=72) indicated that they used the library as a means of requesting scientific articles, compared to 50% (91) who accessed scientific articles through online resources (Table 2). Some of the participants argued that was easier to access from Sci-Hub than from the library.

With regard to the use of the library as a resource for obtaining scientific documents, the main barriers or difficulties for its use, as defined by the users, were the lack of knowledge of the services that the library can offer to users (41.2%), followed by the lack of time to go to the library (34.6%) (Table 2), many of the participants stated that they use the library very sporadically.

When it came to the use of online resources to access scientific articles, it was observed that 50.5% (92) of the participants used general search engines (Google Scholar) as their main reference when searching for information. It was also observed that 30.8% (56) used search engines specific to their areas of knowledge. It is important to highlight that 18.7% (34) indicated that they did not use non-institutional online resources, maybe because the library do not have remote access to the resources subscribed.

Table 3. Access to scientific resources

Access to Scientific Information	N	%
Online Resources	91	50.0
Library	72	39.6
Non use	19	10.4
Barriers to Library use	N	%
Lack of knowledge of the services offered	75	41.2
Lack of time to go	63	34.6
No remote access to documents	32	17.6
Not provide the required service	3	1.6
Delay in providing the service	9	4.9

Use of external resources (not provided by their institutions)	N	%
Use of search engines for databases specific to my area of knowledge	56	30.8
General search engines, such as Google Scholar	92	50.5
Not access to such a service	34	18.7

Finally, when asked where they accessed the search and download of scientific documents if they did not use official resources, it was found that 50.5% (n=92) accessed from their workplace network, compared to 36.8% who accessed via a private/personal network.

Sci-Hub use

Finally, participants were asked to describe whether they knew what Sci-Hub was and whether they used it as a resource for accessing scientific papers.

In this regard, it is worth noting that 81.3% (n=148) of the participants stated that they knew what Sci-Hub was, of which 47.3% (n=86) indicated that it was a platform that provided legal access to scientific articles, compared to 34.1% (62) who recognised that the access provided was obtained in a non-legal way (Table 3).

With regard to usage, it was found that the majority of users, 64.8% (n=118) use Sci-Hub to access scientific papers. Of these, only 8.8% (n=16) indicated that they use it as their first choice, compared to 32.4% (n=59) who stated that they use it sporadically and whenever they do not have access otherwise.

Table 4. Sci-Hub use. (note: in the question What are the reasons for using Sci-Hub, only those users who say they use Sci-Hub have been counted.)

Do you know what Sci-Hub is?	N	%
Yes, it gives legal access to articles	86	47.3
Yes, it gives non-legal access to articles	62	34.1
No	34	18.7
Use of Sci-Hub	N	%
I use it all the time, it is my first choice	16	8.8
Very frequent use	43	23.6
Use sporadically when I don't have access otherwise	59	32.4
Never	64	35.2
What are the reasons for using Sci-Hub?	N	%
Quick, and easy, access	53	29.1
The article is not held by the library	38	20.9
Financial reasons (no access to the journal)	15	8.2
The researcher has no reference library to request documents	7	3.8

Others	4	2.2

In the study of the possible association between sociodemographic variables with Sci-Hub use, it was found that the only variables that offered a significant relationship with respect to some of the parameters assessed with respect to SciHub use were age and academic level. The academic level of the participants was significantly associated with the use of Sci-Hub ($p = 0.008$) (Table 4).

With regard to knowledge of Sci-Hub, age was found to be a significant factor in the knowledge of Sci-Hub ($p<0.001$), younger participants in the questionnaire were more aware of this resource. However, no differences were observed in the age of those who, knowing what Sci-Hub was, defined it as a legal or non-legal platform for accessing articles.

Age was found to be a factor significantly associated with non-use of Sci-Hub versus use ($p<0.001$), older people used less Sci-Hub, while younger people are the ones who use it as their first choice ($p = 0.04$). Furthermore, when asked about the reasons that lead users to use Sci-Hub, it was found that the main reason was that it guarantees quick and easy access 29.1% (n = 53), followed by its use if the document sought is not in the library's possession 20.9% (n = 38) (Table 5). The option 'economic reasons' was selected as the main reason for using Sci-Hub by 8.2% (n = 15) of the participants.

Table 5. Correlation between age and academic degree and Use of Sci-Hub questions.

	Pairs	**p-value**
Academic Degree	Sci-Hub use	n.s.
	¿What is Sci-Hub?	n.s.
	Reason for use Sci-Hub	0.008
Area of Knowledge	Sci-Hub use	n.s.
	¿What is Sci-Hub?	n.s.
	Reason for use Sci-Hub	n.s.
Location	Sci-Hub use	n.s.
	¿What is Sci-Hub?	n.s.
	Reason for use Sci-Hub	n.s.
Age	Sci-Hub use	0.001
	¿What is Sci-Hub?	<0.001
	Reason for use Sci-Hub	n.s

Furthermore, when asked about the reasons that lead users to use Sci-Hub, it was found that the main reason was that it guarantees quick and easy access 29.1% (n=53), followed by its use if the document sought is not in the library's possession 20.9% (n=38). (Table 3). The option "economic reasons" was selected as the main reason for using Sci-Hub by 8.2% (n=15) of the participants.

Discussion

Libraries are responsible for negotiating with academic publishers. The constant increase of journal prices makes it unsustainable for an institution, no matter how large, to have access to all scientific literature [26]. Although libraries are an active part of the negotiation with publishers, they are not the main consumer of journals: they act as intermediaries between authors and readers, and publishers [27]. Moreover, each article is unique and not

substitutable by another similar product, so the fact that it is an irreplaceable good negates the bargaining power of libraries in many cases [6].

Researchers are not aware of the real cost of subscriptions; they only express their needs without participating in the negotiations. Many times, subscription managers are faced with researchers' lack of understanding regarding the acquisition of a journal; they do not understand why there have to be so many journals with embargo periods, for example, to be able to access the journal they are interested in. Libraries have to negotiate bundles of journals because, in the end, it is more expensive to buy only the titles they need than to acquire them in batches [28]. It is difficult to change this system, but there have already been cases of universities refusing such subscriptions, such as the University of Montreal [6], the consortium of German universities [28], or the University of California, which cancelled the subscription with Elsevier in February 2019 until reaching a new agreement in March 2021 [29,30].

There are two main reasons for researchers to use Sci-Hub: the need to access content under a paywall and the immediacy and/or ease of access. Nicholas et al. (2019) reflect on this situation by analyzing the use of Sci-Hub in different countries. In the case of Spain, for example, researchers point to direct access to full texts as the main reason for using Sci-Hub, in addition to using it when the article is not accessible through the library, Google Scholar, or PubMed [31].

However, and in contrast to what Nicholas et al. (2019) indicated, the data reflect that many of the downloads are from locations and institutions where researchers have access to much of the content stored in Sci-Hub and have professionals at their disposal who can help them get the full text, in some cases, only in a matter of hours [21,32,33].

In addition to questions of legality [34] or ease of access, the ethical dilemma that exists concerning healthcare professionals has also been raised: do they have a moral duty to use such information to improve medical care or save lives, even if they do so in breach of copyright? [23,35]. It is necessary to raise a debate on whether "pirate" access is ethical if it is done by researchers from developing countries, "sponsored" in some way by those researchers living in Western countries with full access to the articles. Is the access of a professional from a developed country, who has a network of libraries available to their centre, and where they can request those articles if the institution does not have access to, at the same ethical level as a professional living in an emerging country, who needs to consult articles on some topic to which they cannot access and they do not have a library where make those requests?

Sci-Hub as a form of disobedience to the existing system (of access to scientific information).

This can be understood because its philosophy is based on the idea that knowledge should be free, without any copyright restrictions. Therefore, Sci-Hub could be understood as a tool focused on conveying the desire to fight or disobey the system, which is considered unfair and repressive, regarding access to knowledge. According to Elbakyan, this copyright is unfair because it protects the powerful and penalizes the poor. We are not talking, then, about a simple act of piracy; researchers around the world are supposed to be able to access resources without depending on the

> economic situation of their institution. It highlights several points where the library fails: the difficulty in accessing allocated funds and the negotiations with publishers, in addition to the inequalities between the scientific core and the scientific periphery [17].

Another important factor has been the slower and more complicated than expected level of development of OA. Currently, it is estimated that 50% of scientific articles are available in different OA modalities [3], while Sci-Hub offers access to around 80% of the scientific literature in one place [6].

On the other hand, the pursuit of Sci-Hub is not the same in all countries. While in some countries the downloading of articles from this platform is punishable by law, in others such as Iran, Iraq and Eritrea [36] it is not prosecuted as according to the current legislation in these countries no law is broken [24].

Sci-Hub and publishers

With the massive use of Sci-Hub among researchers worldwide, libraries have become aware that legal access to subscribed resources and services have decreased[37].

Publishers have two positions. On the one hand, some seek to protect content and want to strengthen security. In this sense, some publishers are considering the possibility of no longer offering articles in PDF format to prevent illegal downloads [38,39]. On the other hand, some are betting on making access more convenient and user-friendly. In this sense, discovery systems implemented in libraries try to facilitate access to full texts, creating more user-friendly systems.

Another problem is that Sci-Hub does not offer any alternative to the traditional publishing system (neither editorial services nor peer review). Not only does it facilitate access to the publications of large publishers, but it may lead to the disappearance of many small publishers and journals belonging to scientific societies, which survive thanks to funds obtained through subscriptions [21,24]. (Figure 1)

Figure 1. Sci-Hub’s ecosystem

Sci-Hub, a learning opportunity for libraries

With the massive use of Sci-Hub among researchers worldwide, libraries have become aware that legal access to subscribed resources is cumbersome and requires many more steps than those required in Sci-Hub [40,41]. The immediacy of Sci-Hub access is the reason why it is so successful and makes researchers decide to give institutional credentials without being aware that they grant access to more services than just the library's own [20]. In the case of hospital centers, they can also give access to patient records, for instance in the case of the Balearic Islands (Spain) system access, they use the same password for the patients records and library resources. In an analysis made in 2019, we could see that the articles more downloaded in Spain were from health sciences and engineering [42]

Users should be trained in information search and retrieval. Sci-Hub does not replace databases or discovery tools, as it does not allow search and replication strategies, it only retrieves full texts from some data (DOI, title, PMID, URL) [23]. It is common to find examples of articles in which Sci-Hub is included as if it were a database, and not the tool used to get the full text [43,44].

This would be a great opportunity to redefine the role of libraries and promote the figure of embedded librarians[45]: a hybrid professional researcher/librarian who does not try to teach information literacy skills using guides but rather solves things directly [46]. A librarian integrated into the research process can make it easier both to conduct searches and to obtain the full text of documents in a legal manner. In addition, libraries need to rethink the improvement of their full-text access services. They should offer a service that is similar in usability to Sci-Hub.

Conclusions

In different conferences and articles, there is already talk of the proposal to create a service similar to Spotify or some Netflix of scientific articles. If it is finally implemented, will it be the decrease of piracy as it happened with cinema and music? Will libraries be able to give

greater access to users through friendlier platforms? We are talking about two different ecosystems, that of music and film, and that of scientific communication. In the former, the creators of these multimedia contents receive financial compensation for the content created; researchers, on the other hand, do not receive any direct financial benefit for their publications or for the role they play in the scientific communication system as reviewers or journal editors [40]. The benefit obtained by researchers is linked to the scientific evaluation system, which values their activity based on the publication of articles and their participation in the science communication system. Researchers are consumers and creators, being the access necessary to be able to do research, and they are forced to publish to progress in their scientific career.

Even more, users should be trained in information search and retrieval. Sci-Hub does not replace databases or discovery tools, as it does not allow search and replication strategies, it only retrieves full texts from some data (DOI, title, PMID, URI) [24]. It is common to find examples of articles in which Sci-Hub is included as if it were a database, and not the tool used to get the full text [43,44].

In our analysis, we can see that researchers know that they are using pirate access, even when they have access to a virtual library, but they do not mind. They think that immediacy is more important than copyright issues, bypassing the steps involved in accessing through the library, and in some cases, the library do not have remote access. Regarding the age of users that use Sci-hub, most of the participants are from generations born with Internet access available, and different social networks and communication vias, so is not a surprise to see they are the most willing to use these kinds of illegal resources.

There are some different tools to help libraries to avoid or minimize that their users use Sci-Hub instead of library services and resources, such as EndNote Click or Unpaywall, both have the option to be configurated to access directly from search platforms such as PubMed or directly on the journal webpage the library subscribes or other legal resources like institutional repositories. Teach to the users how to install and use tools such as EndNote Click or Unpaywall, is mandatory to fight against piracy

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