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# The use of shadow libraries at Universitas Indonesia

## by Fauzan Eka Kusuma and Rahmi Rahmi

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### Abstract

Shadow libraries (SLs), such as Sci-Hub, Z-Library, and Library Genesis (LibGen), are online databases that provide content that is otherwise difficult to access (due to paywalls or other copyright controls) using unofficial methods of questionable legality. Interest in the SL phenomenon has focused on copyright infringement that occurs when a database provides library materials, for which access rights need to be purchased, without the knowledge of a given copyright owner. This study analyzes the use of SLs at the Universitas Indonesia (UI). The research uses a quantitative approach, with a survey distributed to 262 undergraduate students at UI. The frequency of SL use in academic activities of UI students is compared with the use of the UI Online Public Access Catalog (OPAC UI). The results show that most UI students have not used SLs. However, those who have used SLs report more positive impressions and higher levels of satisfaction compared with OPAC UI.

### Contents

- [1. Introduction](#)
  - [2. Literature review](#)
  - [3. Methodology](#)
  - [4. Results](#)
  - [5. Discussion](#)
  - [6. Conclusions](#)
  - [7. Suggestions](#)
- 

## 1. Introduction

The development of digital libraries in modern times has given rise to a type of online database that lurks in the shadows. The term *shadow library* (SL) is applied to online databases that provide content that is otherwise difficult to obtain or access (due to paywalls or other copyright controls) using unofficial methods of questionable legality (Greshake, 2017; Kjellström, 2022; Mejia, *et al.*, 2017). Well-known examples of these databases are non-profit organizations like Sci-Hub, Z-Library, and Library Genesis (LibGen). Sci-Hub provides access to millions of research articles and books. Z-Library is a shadow library initiative offering collective access to scientific journals, academic literature, and regular books. LibGen, referring to itself as a “link aggregator,” offers a database comprising materials “gathered from publicly accessible Web sources as well as files shared by its users” (LibGen, 2020).

In general, SLs are seen by many as an examples of large-scale copyright infringement, and many of them have been taken to court by publishers. In 2015, Sci-Hub and LibGen became embroiled in a legal case with Elsevier, who accused them of infringing copyrights and providing free access to articles and books

using credentials from ScienceDirect, a subsidiary of Elsevier (Glance, 2015). Later that year, following Elsevier's complaint, the District Court for the Southern District of New York ordered LibGen to close and suspended the use of its Web site's domain name, libgen.org, forcing it to use a new domain name (van der Sar, 2015). Meanwhile, Sci-Hub and its founder, Alexandra Elbakyan, were sued twice for copyright infringement in the United States in 2015 and 2017 and lost both cases, leading to the loss of some of the site's domain names.

Although SLs may be unlawful, their development and use frequency have not diminished. Bohannon (2016) has shown that Sci-Hub download requests originate from three million unique IP addresses. However, the number of users is thought to be much higher because thousands of university students may share the same IP address. Sci-Hub downloaders have been detected on every continent except Antarctica. As of March 2017, Sci-Hub had 62 million papers in its collection, 85 percent of which were articles published in paywalled scientific journals, and a 2019 study of 27.8 million download requests for Sci-Hub showed that 23.2 million were for journal articles (Till, *et al.*, 2019). Other research has shown that SL users include students with a positive opinion of the SL they use. According to Mejia, *et al.* (2017), 19.2 percent of their study participants from Latin America were aware of Sci-Hub and its functions, and, on average, they use it twice per month; moreover, 29.9 percent of participants who use Sci-Hub claimed they are always able to find the scientific information they want in their Sci-Hub searches; 62.5 percent of participants agreed that Sci-Hub contributes positively to scientific investigations, and only 2.2 percent thought that Sci-Hub did not contribute to science. These findings underscore the fact that the academic community frequently uses resources like SLs, even though they may not be fully legal.

Higher education libraries that provide online access have become a major institutional investment as tools to find library resources legally. According to Suharso, *et al.* (2020), most university libraries have developed their digital libraries using the help of Web sites, such as digilib, library, and lib., or applications that can be accessed via the Internet. For example, the Library Building of the Universitas Indonesia (UI) can accommodate approximately 10,000 visitors at the same time or 20,000 visitors per day. It can accommodate three to five million book titles and is equipped with reading rooms, 100 silent rooms for lecturers and students, and a loan system based on information and communication technologies (Hidayat and Mulyadi, 2011). However, the UI Library also has a presence in the virtual world: It provides the UI Online Public Access Catalog (OPAC UI), which is an online database service that is accessed via the Internet using a single sign on (SSO) UI account. OPAC UI helps library users find information about the completeness and storage location of the library's physical collections; it also provides access to the library's digital collections. At the time of writing, OPAC UI provides 8,908 eBooks, 19,180 final assignments, 61,713 master theses, 93,486 undergraduate theses, and 3,294 dissertations as digital collections for download. In addition, OPAC UI subscribes to several online databases that users can access via the remote-lib.ui.ac.id page. In total, 34 online databases can be accessed through this page, including JSTOR, ProQuest, ScienceDirect, Scopus, EBSCOhost, Cambridge Core, SpringerLink, and Emerald Insight.

This research investigates the use of shadow libraries (SLs) in Indonesia, employing the same questions utilized by Mejia, *et al.* (2017) concerning the usage, understanding, and perceptions of SLs. Data was obtained through a survey given to actively enrolled students at UI from the cohorts of 2019 to 2022. The collected data seeks to answer the following research questions:

1. How often do students use SLs for their academic activities compared to UI's Online Public Access Catalog (OPAC UI)?
2. What prompts students to use SLs over OPAC UI?
3. What are the UI students' opinions regarding the legality of SLs?

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## 2. Literature review

## 2.1. Digital libraries

Digital libraries manage all or a substantive portion of their collections in computerized form as an alternative, supplement, or complement to conventional prints in the form of micro materials, which are dominated by library collections [1]. In contrast to traditional libraries, which are assigned with collecting, managing, preserving, and serving collections in physical forms, digital libraries store collections that can be accessed online via a network [2]. Borgman (1999, as cited in Xie and Matusiak, 2016) attempted to define digital libraries in a way that bridges two conflicting approaches between researchers and practitioners. Researcher-oriented definitions tend to provide a narrower view, as they concentrate more on the technical aspects of digital formats, information architectures, and information retrieval, whereas practice-oriented definitions view digital libraries in a social and institutional context and emphasize service aspects. Borgman's definition has two elements that cover both approaches:

1. A digital library is a set of electronic resources and related technical capabilities for creating, searching, and using information.
2. Digital libraries are built, aggregated, and managed by (and for) a community of users, and their functional capabilities support the information needs and uses of that community.

Arms (2000, as cited in Xie and Matusiak, 2016) combined a computer science approach with a librarian's perspective and defined a digital library as a collection of information that is managed in digital format with associated services and can be accessed via a network, emphasizing the importance of quality of curated collections in which digital objects are described and arranged systematically and made available to the public through a clear traceable interface. Furthermore, Hartono (2017) outlined five roles of digital libraries in the information age:

1. The digital library is tasked with collecting and providing information in electronic form in accordance with the information needs of the community.
2. Digital libraries transform the organization of information by paying attention to information technology, metadata, information-retrieval systems, and telecommunications networks as well as by adopting Internet infrastructure and carrying out digitalization techniques professionally.
3. Digital libraries play a role in disseminating their digital collections, which can be accessed by the user community quickly, precisely, accurately, and easily.
4. Digital libraries play a role in preserving digital collections and the valuable information they contain.
5. Digital libraries play a role in explaining information ethics and regulations on access rights to the public to help them avoid copyright infringement and plagiarism.

## 2.2. Shadow libraries

A SL is a digital library or online database that provides content that is otherwise difficult to obtain or access (due to paywalls or other copyright controls) using unofficial methods of questionable legality. According to Karaganis (2018), SLs reorganize the flow of educational and research materials from authors to publishers, libraries, students, and researchers as well as from relatively affluent universities to poorer ones. Bodó (2016) emphasized that the growth and success of these Web sites have been facilitated by market dynamics and technological advancements. The proliferation and increased usage of shadow libraries are connected to the simultaneous rise in demand for academic content in developing countries and the inability of major commercial publishers to set appropriate prices for their services. In this study, three SLs were chosen as the most popular examples: Sci-Hub, Z-Library, and LibGen. According to Gardner, *et al.* (2017), the most well-known SL is LibGen in combined use with Sci-Hub, which uses a collection of

university credentials to access articles and add them to the LibGen repository. An article from the GreyCoder Web site by Web Master (2022) includes Z-Library with Sci-Hub and LibGen in a list of the largest SLs, noting that Z-Library has 10 million books and 86 million articles.

**Sci-Hub.** Sci-Hub was launched in 2011 by Aleksandra Elbakyan, a student, as a search and download service for journal articles. Sci-Hub is connected to LibGen: A search for an article on Sci-Hub will trigger the same search on LibGen. If an article is not found in LibGen, Sci-Hub searches the main journal database using the obtained credentials. When a user downloads a copy, Sci-Hub simultaneously uploads a copy to LibGen, ensuring that subsequent document requests can be fulfilled from within the collection (Karaganis, 2018). As of 2016, Sci-Hub/LibGen had grown to approximately 50 million articles and, over a six-month period in 2015–2016, had over 28 million downloads (Bohannon, 2016).

Sci-Hub is easy to use, offering simple and quick access to full-text articles in PDF format in a more accessible manner than many library or publisher Web sites (Gardner, *et al.*, 2017). Sci-Hub's interface is simple and friendly, similar to Google; users can access a document using only a digital object identifier or a text title (González-Solar and Fernández-Marcial, 2019). According to Oakley (2016), Sci-Hub is easier to use than Georgetown University's OPAC (OPAC GU). For instance, to access an article from a subscribed journal from OPAC GU, it takes six clicks and 24 seconds, whereas, on Sci-Hub, it only takes two clicks and 10 seconds. Moreover, to access an article from an unsubscribed journal, it requires 1.45 minutes plus waiting time for delivery of the interlibrary loan, whereas, on Sci-Hub, it only takes two clicks and 10 seconds.

Sci-Hub's relationship with open access (OA) is controversial. According to Piwowar, *et al.* (2018, as cited in González-Solar and Fernández-Marcial, 2019), Sci-Hub is not considered part of the OA movement. Bohannon (2016) stated that the OA movement can pay a "strategic cost" when it is associated with piracy. Greshake (2017) described Sci-Hub as using semi-legal or illegal means to access scientific publications. OA itself is considered legal, as explained in an answer to a parliamentary question to the Danish Minister of Higher Education and Science, who said that the ministry had adopted an OA policy that "recommends" researchers to make their research publicly available because OA is not copyright infringement. Telling others that they should publish their work online for free is, by law, not copyright infringement, as those who make the recommendations have in no way made copies of the work or published it without permission (Rosenmeier, n.d.).

**Library Genesis.** LibGen is an SL created by Russian scientists around 2008. LibGen, as an SL and pirated content distribution service, has a unique manner of operation. Most of these kinds of Web sites tend to exercise tight control over content that they make accessible and their infrastructure. LibGen, in contrast, provides OA to collections by making them radically open, gathering free scholarly text and other collections from the Internet and consolidating them (both content and metadata) into one open database (Bodó, 2018).

Like Sci-Hub, LibGen has the advantage of being easy to access, with an interface and search tools similar to Sci-Hub, as well as providing fast access. Oakley (2016) compared LibGen with OPAC GU and found that, for the latter, to access books that the library already has, users need to go through five different stages (browse the catalog, secure the call number, specify the format, see if the book is available, and go to the stack or download eBooks) in the OPAC GU. In contrast, through LibGen, they only need to make four clicks in 33 seconds. Moreover, in OPAC GU, to access books that the library does not own, users need to go through three steps (view the catalog, find where books are available, and request a consortium or interlibrary loan) and then wait for the delivery, whereas, with LibGen, the process is the same as before, and they only need to make four clicks in 33 seconds.

**Z-Library.** The main page of the Z-Library site says that it has been providing free eBooks since 2009 (Kjellström, 2022). Like LibGen and Sci-Hub, Z-Library's strengths include speed of access, comprehensive collection, and ease of browsing. According to Kjellström (2022), Z-Library overlaps with part of the LibGen collection but was removed from the design and administration of LibGen; the only

quality they share is part of their catalog. Kjellström (2022) examined how Z-Library uses various techniques found in gamification design to crowdsource administration from its user base. Z-Library users can participate in library administration tasks, such as the metadata section. Editing, uploading, and tagging are the most basic aspects of metadata work for a functioning library catalog, and, because this work is performed by a large user base and not a single individual, it is necessary to ensure that the quality of each post reaches a minimum acceptable standard, namely searchability (Kjellström, 2022). On 4 November 2022, in the midst of writing this article, a series of Z-Library domain names were confiscated by the FBI, and the homepage now bears the U.S. Department of Justice stamp (Woodcock, 2022). For the time being, the Z-Library domain has been closed and can no longer be used. Because this is a recent development, the FBI's New York press office declined to comment on the article cited.

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### 3. Methodology

This study collected data through surveys, aiming to obtain both quantitative and qualitative responses from participants (Fowler, 2013). The study incorporated both closed-ended and open-ended questions. The benefits of using this approach are its cost efficiency, capability to gather information from a broad range of respondents, and possibility of analyzing correlations between various factors (Fowler, 2013).

The subjects of this study were active students at UI from the classes of 2019 to 2022. The sampling technique was convenience sampling. According to Dörnyei (2007, as cited in Etikan, *et al.*, 2016), convenience sampling (also known as haphazard sampling or accidental sampling) is a type of nonprobability or nonrandom sampling in which members of the target population meet certain practical criteria, such as ease of accessibility, geographical proximity, availability at any given time, or willingness to participate in the research. According to Sedgwick (2013), in the convenience sampling method, respondents are selected because of convenient access, and not all members of the population have the same chance of being selected. This is in contrast to random sampling, in which each member of the population has a known and usually equal probability of being selected. Convenience sampling is more suitable for this study due to time constraints, the very large population, which is around 28,000 students, and the data collection method used.

Data collection was carried out via questionnaire, which was distributed through the SurveyMonkey platform. The questionnaire was administered online so that the respondents, who were guaranteed anonymity, could feel comfortable answering questions about sensitive topics (Leavy, 2022). Another advantage of this approach was the ability to collect various data from a large number of student respondents, which ensured the research results are highly generalizable (Leavy, 2022).

The questionnaire was open from 16 September to 13 October 2022. It was distributed through private channels (personal chat) and class groups via the LINE application, with assistance from a questionnaire-filling service from the UI Campus Survey and the UI Student Executive Board, which helped add 213 respondents out of a total of 309 before screening. Screening of the responses was then performed manually in Microsoft Excel to filter out duplicate or invalid data. After screening, there were 262 valid responses.

The research instrument was adapted from Mejia, *et al.* (2017) regarding the use, knowledge, and perception of the scientific contribution of Sci-Hub in medical students. The questionnaire consisted of two parts (see in the [Appendix](#)). The first part covered demographic data, including name, gender, field of study, and generation of respondent. The second part covered the core questions and consisted of six variables; four of these variables covered knowledge, frequency of use, level of satisfaction, and positive contribution, and the remaining two variables were collection variables adapted from their scale assessment of the level of satisfaction variable. In addition to these six variables, the questionnaire included an access variable due to the personal observations of researchers, who were aware that many UI students admitted difficulties in creating an account to access OPAC UI. The access variable was broken down into two

questions, namely 1) the ease of creating/activating an account and 2) the ease of performing searches in the UI OPAC or SL interface. The survey ended with an open question regarding the respondents' opinions and concerns about the legality of SLs.

The research instrument used a three-point scale with a different label for each variable, except the knowledge variable, which used a YES/NO scale adapted from Mejia, *et al.* (2017). The three-point scale was used for contribution variables (1 = no, 2 = neutral, 3 = yes), frequency of use (1 = never, 2 = sometimes, 3 = always), access (1 = not easy, 2 = fairly easy, 3 = very easy), collection (1 = not complete, 2 = fairly complete, 3 = very complete), and level of satisfaction (1 = not satisfied, 2 = fairly satisfied, 3 = very satisfied).

A reliability test was carried out for the knowledge variable, used for bivariate analysis. According to Bertani, *et al.* (2018), bivariate analysis explores how the dependent variable (“result”) depends on or is explained by the independent variable (“explanatory”) as an asymmetric analysis or alternatively explores the relationship between two variables without a cause–effect relationship (symmetric analysis). The knowledge variable reliability test was carried out using Cronbach’s alpha with a result of 0.814, which indicates robust reliability (Taber, 2018).

The analysis was divided into two parts: demographic and descriptive analysis. In the demographic analysis, respondents were categorized based on three factors, namely gender (male or female), class (2019, 2020, 2021, or 2022), and field of study (Science & Technology, Social & Humanities, Health, or Vocational Education). The demographic analysis looked at the use of SLs and the use of the three types of SL sites: Sci-Hub, Z-Library, and LibGen. The chi-square test was used to calculate the p-value to determine the significance of the relationships between the students’ demographic factors and answers for each question. The chi-square test is a statistical test used to compare observed results with expected results and aims to determine whether the difference between them is due to chance or an existing relationship between the studied variables (University of Southampton, n.d.). Therefore, the chi-square test can help researchers better understand and interpret the relationship between two categorical variables. The confidence interval (CI) used for the analysis was 95 percent. A 95 percent CI means that, if we take 100 different samples and calculate a 95 percent CI for each sample, then approximately 95 out of 100 CIs will contain the true mean value (Sullivan, n.d.).

Descriptive analysis was used to examine the number of respondents who know what an SL is and its types and to compare the use of SLs and OPAC UI through the six variables in the questionnaire. Bivariate analysis was performed to analyze the relationship between variables for each SL and OPAC UI. The mean score is the average value of the respondents’ answers based on the three-point questionnaire scale and was used to compare the values obtained for the SLs and OPAC UI. All results are presented in tables and figures. The answers to the open question at the end of the questionnaire are also discussed at the end of the descriptive analysis.

The analysis will involve an open-ended question: “Do you care if accessing collections via shadow libraries (like SciHub, Library Genesis, Z-Library) is illegal and infringes copyright? If YES/NO, please explain why.” This approach was undertaken to avoid constraining respondents to predefined responses. Instead, it permitted respondents to articulate their thoughts, feelings, or experiences in their own terminology, yielding a depth of data that could expose insights not attainable through closed-ended questions (Braun and Clarke, 2006; Krippendorff, 2018). Despite the complexity, the comprehensive and detailed data derived from this open-ended query can offer invaluable insights into the experiences, viewpoints, and the interpretations respondents assign to these experiences.

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## 4. Results

#### 4.1. Demographic analysis

[Table 1](#) shows the demographic data of the respondents. The majority of respondents who participated in the survey were female, totaling 186 respondents (71 percent) compared to 76 males (28.9 percent). The class of 2021 was the largest group of survey participants with 98 respondents (37.4 percent), followed by the class of 2022 with 88 (33.6 percent), the class of 2019 with 42 (16 percent), and the class of 2020 with 34 (13 percent). By field of study, 50 percent of respondents were from the Social & Humanities cluster with a total of 131, followed by the Science & Technology cluster with 75 (28.6 percent), the Vocational Education Program cluster with 29 (11 percent), and the Health Sciences with 27 (10.3 percent).

**Table 1.** Respondent demographic data (N=262)

Factor	Category	n	%	cPR (CI95%)
Sex	Male	76	28.9	1.71 (1.65–1.77)
	Female	186	71.0	
Class	2019	42	16.0	2.89 (2.76–2.31)
	2020	34	13.0	
	2021	98	37.4	
	2022	88	33.6	
Field of study	Science & Technology	75	28.6	1.82 (1.70–1.95)
	Social & Humanities	131	50.0	
	Health Sciences	27	10.3	
	Vocational Educational Program	29	11.0	

[Table 2](#) shows the knowledge variable, which examines how many respondents have used an SL. Of the 76 male respondents, 34 (44.7 percent) have used an SL and 42 (55.3 percent) have not. Of the female respondents, 87 (46.8 percent) have used an SL and 99 (53.2 percent) have not. The class that uses SLs the most is the class of 2019, of which 35 (83.3 percent) respondents have used one, followed by the class of 2020 with 22 (64.7 percent), the class of 2021 with 44 (44.9 percent), and the class of 2022 with only 20 (22.7 percent). By field of study, the respondents from the Social & Humanities cluster have the largest number of SL users, with a majority of 73 (55.7 percent) respondents being SL users. A majority of respondents from the Health Sciences group, namely 14 (51.9 percent), are also SL users. Only 27 (36 percent) respondents of the Science & Technology cluster respondents have used an SL, and only seven (24.1 percent) respondents from the Vocational Educational Program cluster have used an SL. Overall, of the 262 valid respondents, 141 of them have not used an SL and 121 have.

**Table 2.** Respondent demographic relationship with the knowledge of shadow libraries variable

Factor	Using Shadow Library <i>n</i> (%)		<i>p</i> -value
	No	Yes	
<b>Sex</b>			0.436
Male	42 (55.3)	34 (44.7)	
Female	99 (53.2)	87 (46.8)	
<b>Class</b>			0.000**
2019	7 (16.7)	35 (83.3)	
2020	12 (35.3)	22 (64.7)	
2021	54 (55.1)	44 (44.9)	
2022	68 (77.3)	20 (22.7)	
<b>Field of Study</b>			0.003*
Science & Technology	48 (64.0)	27 (36.0)	
Social & Humanities	58 (44.3)	73 (55.7)	
Health Science	13 (48.1)	14 (51.9)	
Vocational Education Program	22 (75.9)	7 (24.1)	
<b>Total</b>	<b>141 (53.8)</b>	<b>121 (46.2)</b>	

\* $p < 0.05$ , \*\* $p = 0.000$ 

[Table 3](#) shows how many respondents have used the Sci-Hub SL: 25 (9.5%) male respondents are Sci-Hub users compared to 68 (26.0 percent) female Sci-Hub users. The class of 2021 is the class that uses Sci-Hub the most, with 36 (13.7 percent) of them being Sci-Hub users, followed by 25 (9.5 percent) in the class of 2019, 17 (6.5 percent) in the class of 2022, and 15 (5.7 percent) in the class of 2020. Of the valid respondents, 50 (19.1 percent) from the Social & Humanities cluster are Sci-Hub users, followed by the Science & Technology cluster with 24 (9.2 percent), the Health cluster with 13 (5.0 percent), and the Vocational Educational Program with six (2.3 percent). Overall, 93 (35.5 percent) of the respondents are users of Sci-Hub and 169 (64.5 percent) are not.

**Table 3.** Respondents who have used Sci-Hub

Factor	Used Sci-Hub <i>n</i> (%)		<i>p</i> -value
	No	Yes	
<b>Sex</b>			0.339
Male	51 (19.5)	25 (9.5)	
Female	118 (45.0)	68 (26.0)	
<b>Class</b>			0.000**
2019	17 (6.5)	25 (9.5)	
2020	19 (7.3)	15 (5.7)	
2021	62 (23.7)	36 (13.7)	
2022	71 (27.1)	17 (6.5)	
<b>Field of Study</b>			0.140
Science & Technology	51 (19.5)	24 (9.2)	
Social & Humanities	81 (30.9)	50 (19.1)	
Health Science	14 (5.3)	13 (5.0)	
Vocational Education Program	23 (8.8)	6 (2.3)	
<b>Total</b>	<b>169 (64.5)</b>	<b>93 (35.5)</b>	

\* $p < 0.05$ , \*\* $p = 0.000$ 

[Table 4](#) shows how many respondents have used LibGen. The number of LibGen users as a whole is less than the number of Sci-Hub users, with only 45 (17.2 percent) respondents reporting that they have used it compared to 217 (82.8 percent) who have not. Of these users, 18 (6.9 percent) are male and 27 (10.3



percent) are female. The class of 2021 uses LibGen the most, with 15 (5.7 percent) users, followed by the class of 2019 with 12 (4.6 percent) and the classes of 2020 and 2022, both of which have nine (3.4 percent). Moving to the field of study factor, respondents from the Social & Humanities cluster have 21 (8.0 percent) users, followed by those from the Science & Technology cluster with 11 (4.2 percent), the Health cluster with eight (3.1 percent), and the Vocational Educational Program with five (1.9 percent).

**Table 4.** Respondents who have used LibGen

Factor	Used LibGen <i>n</i> (%)		<i>p</i> -value
	No	Yes	
<b>Sex</b>			0.057
Male	58 (22.1)	18 (6.9)	
Female	159 (60.7)	27 (10.3)	
<b>Class</b>			0.028*
2019	30 (11.5)	12 (4.6)	
2020	25 (9.5)	9 (3.4)	
2021	83 (31.7)	15 (5.7)	
2022	79 (30.2)	9 (3.4)	
<b>Field of Study</b>			0.334
Science & Technology	64 (24.4)	11 (4.2)	
Social & Humanities	110 (42.0)	21 (8.0)	
Health Science	19 (7.3)	8 (3.1)	
Vocational Education Program	24 (9.2)	5 (1.9)	
<b>Total</b>	<b>217 (82.8)</b>	<b>45 (17.2)</b>	

\* $p < 0.05$ , \*\* $p = 0.000$

[Table 5](#) shows how many respondents have used Z-Library. Overall, the number of Z-Library users in the sample is larger than the number of LibGen users but smaller than the number of Sci-Hub users. Of the valid respondents, 80 (30.5 percent) have used Z-Library and 182 (69.5 percent) have not. Of the users, 24 (9.2 percent) are male and 56 (21.4 percent) are female. The class of 2021 is the class that uses Z-Library the most, with a total of 28 (10.7 percent) users, followed by the class of 2019 with 23 (8.8 percent), the class of 2020 with 15 (5.7 percent), and the class of 2022 with 14 (5.3 percent). Next, looking at the group of knowledge factors, there are 51 (19.5 percent) users from the Social & Humanities cluster, followed by 11 (4.2 percent) respondents from the Science & Technology cluster, 14 (5.3 percent) from the Health cluster, and four (1.5 percent) from the Vocational Education Program cluster.

**Table 5.** Respondents who have used Z-Library

Factor	Used Z-Library <i>n</i> (%)		<i>p</i> -value
	No	Yes	
<b>Sex</b>			0.462
Male	52 (19.8)	24 (9.2)	
Female	130 (49.6)	56 (21.4)	
<b>Class</b>			0.000**
2019	19 (7.3)	23 (8.8)	
2020	19 (7.3)	15 (5.7)	
2021	70 (26.7)	28 (10.7)	
2022	74 (28.2)	14 (5.3)	
<b>Field of Study</b>			0.000**
Science & Technology	64 (24.4)	11 (4.2)	
Social & Humanities	80 (30.5)	51 (19.5)	
Health Science	13 (5.0)	14 (5.3)	
Vocational Education Program	25 (9.5)	4 (1.5)	
<b>Total</b>	<b>182 (69.5)</b>	<b>80 (30.5)</b>	

\* $p < 0.05$ , \*\* $p = 0.000$

[Table 6](#) shows the relationships between demographic data and variables for SL generated by conducting a paired-samples *t*-test. The paired-samples *t*-test compares the averages of two groups of people or matched cases or compares the averages of one group examined at two different times (Ross and Willson, 2017). If the same group is tested again, on the same measure, the *t*-test is called a repeated-measures *t*-test. The paired-samples *t*-test helps us determine whether the difference between the two variables is significant, with  $p < 0.05$  indicating a significant difference and  $p > 0.05$  indicating a non-significant difference. For both sex and faculty, a significant relationship can be seen with all variables. In addition, a significant relationship exists between the force factor and the contribution variable. However, there is no significant relationship between the force factor and other variables.

**Table 6.** Paired-samples *t*-test between demographic data and shadow library variables ( $n=121$ )

Factor	Contribution	Frequency of Usage	Account Creation	Search	Collection	Satisfaction Level
Sex	-14.128, $p = 0.000$ **	-8.485, $p = 0.000$ **	-7.539, $p = 0.000$ **	-9.193, $p = 0.000$ **	-7.113, $p < 0.000$ **	-8.616, $p = 0.000$ **
Class	-2.228, $p < 0.028$ *	0.907, $p < 0.366$	1.184, $p < 0.239$	0.215, $p < 0.830$	1.766, $p < 0.080$	0.874, $p < 0.384$
Field of Study	-10.354, $p = 0.000$ **	-7.401, $p = 0.000$ **	-6.220, $p = 0.000$ **	-7.243, $p = 0.000$ **	-6.377, $p = 0.000$ **	-7.096, $p = 0.000$ **

\* $p < 0.05$ , \*\* $p = 0.000$

[Table 7](#) shows the relationship between demographic data and variables for OPAC UI generated by conducting a paired-samples *t*-test. A significant relationship exists between gender, class, and family with all OPAC UI variables, except the relationship between the age factor and the contribution variable, which is not significant.

**Table 7.** Paired-samples *t*-test between demographic data and the Universitas Indonesia Online Public Access Catalog ( $n=121$ )

Factor	Contribution	Frequency of Usage	Account Creation	Search	Collection	Satisfaction Level
Sex	-14.128, $p = 0.000^{**}$	-3.642, $p = 0.000^{**}$	-5.590, $p = 0.000^{**}$	-4.842, $p = 0.000^{**}$	-5.081, $p = 0.000^{**}$	-5.196, $p = 0.000^{**}$
Class	-.148, $p < 0.882$	3.327, $p < 0.001^*$	2.937, $p < 0.004^*$	3.272, $p < 0.001^*$	3.464, $p < 0.001^*$	3.410, $p < 0.001^*$
Field of Study	-7.917, $p = 0.000^{**}$	-3.757, $p = 0.000^{**}$	-4.464, $p = 0.000^{**}$	-4.178, $p = 0.000^{**}$	-4.558, $p = 0.000^{**}$	-4.608, $p = 0.000^{**}$

\* $p < 0.05$ , \*\* $p = 0.000$

#### 4.2. Descriptive analysis

[Table 8](#) shows the respondent answers to the question about their SL knowledge. The question aims to understand the respondents' awareness of the existence of SLs and different types. In line with the results of the demographic analysis, which show that Sci-Hub is the most popular SL, followed by Z-Library, then LibGen, the number of respondents who know that Sci-Hub is an SL is larger than the others, namely 105 (40.1 percent) out of a total of 262. Z-Library follows with 86 (32.8 percent), and LibGen is in last position with 66 (25.2 percent).

**Table 8.** Respondents' knowledge of shadow library status

Sites	Knowing that the Site Includes a Shadow Library $n$ (%)	
	No	Yes
Sci-Hub	157 (59.9)	105 (40.1)
Library Genesis	196 (74.8)	66 (25.2)
Z-Library	176 (67.2)	86 (32.8)

The main focus of the descriptive analysis is the presentation of 121 SL users' answers to questions related to research variables to compare their use of and opinions about SLs and OPAC UI. Related variables include the library's contribution to academic activities, frequency of library use, ease of access (divided into ease of account creation/activation and ease of searching in the library interface), completeness of library collections, and the level of satisfaction experienced by respondents after using each library. [Table 9](#) shows the variable scale categories; the larger the number, the more positive the answer given by the respondent. The variable rating scale is based on an interval scale. The interval scale is obtained by reducing the highest value (3) by the lowest value (1) and dividing it by the number of values on the scale (3). The result (0.666) is the range of values in one category.

**Table 9.** Variable scale categories

Scale	Category
1.00–1.66	Low: never/easy/complete/satisfied
1.67–2.33	Moderate: neutral, occasional, fairly easy/complete/satisfied
2.34–3.00	High: yes, always, very easy/complete/satisfied

**Table 10** shows the correlations between SL variables. The average value of the SL variables is 2.35, with a standard deviation (STD) of 0.590. The value of 2.35 is in the high category. The variable with the highest average value is the contribution variable, with a score of 2.64, whereas the collection variable has the lowest score at 2.21. The contribution and search variables are the two variables with high scores; all other variables have moderate scores. The highest correlation between two variables is between the search and account usage variables, with a score of 0.664.

**Table 10.** Correlation results between shadow library variables

Variable	N	Item	Mean	STD	1	2	3	4	5	6
Contribution	121	1	2.64	0.561	1.00					
Frequency of Usage	121	1	2.30	0.572	0.410**	1.00				
Account Creation	121	1	2.26	0.616	0.226*	0.390**	1.00			
Search	121	1	2.38	0.649	0.306*	0.411**	0.664**	1.00		
Collection	121	1	2.21	0.604	0.292**	0.447**	0.389**	0.436**	1.00	
Satisfaction Level	121	1	2.31	0.560	0.402**	0.520**	0.512**	0.480**	0.550**	1.00

\*\* Significant correlation ( $p$ ) at the level  $\leq 0.01$ , \* Significant correlation ( $p$ ) at the level  $\leq 0.05$

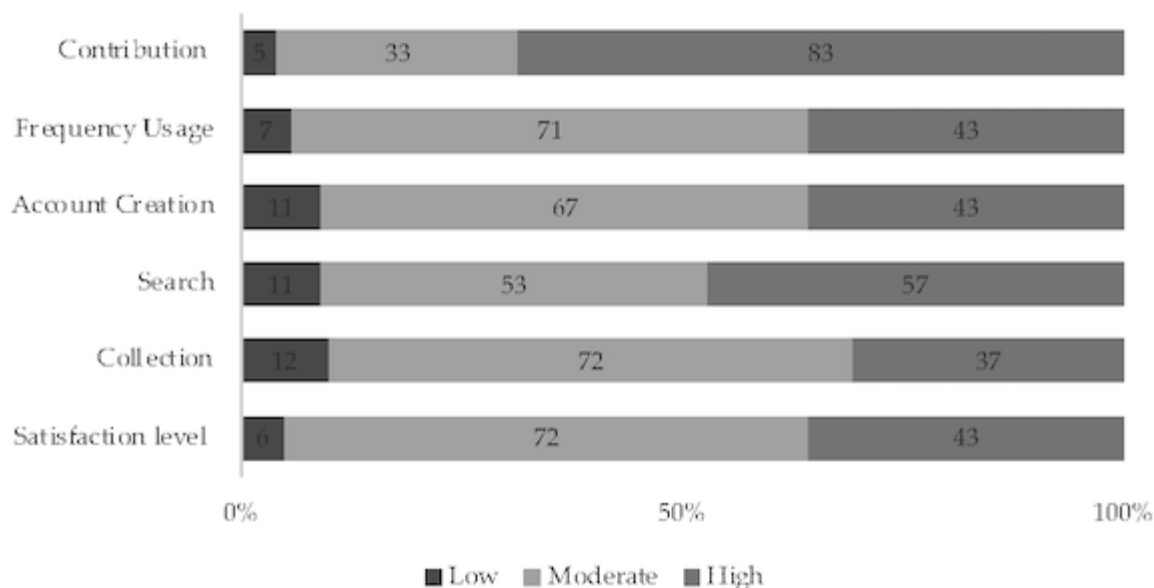
**Table 11** shows the correlations between the variables for OPAC UI. The OPAC UI average value is 2.11, with an average STD of 0.592. The value of 2.11 is in the medium category. All OPAC UI variables have lower average values than the SL variables. As in the SL results, the variable with the highest average value is the contribution variable, with a score of 2.42, whereas the frequency of use variable, with a score of 2.00, has the lowest value. Of all variables, only the contribution variable has a high score; all other variables have a moderate score. The highest correlation between two variables is between the collection variable and the satisfaction level variable, with a score of 0.580.

**Table 11.** Correlations between the variables for the Universitas Indonesia Online Public Access Catalog

Variable	N	Item	Mean	STD	1	2	3	4	5	6
Contribution	121	1	2.42	0.704	1.00					
Frequency Usage	121	1	2.00	0.632	0.468**	1.00				
Account Creation	121	1	2.09	0.548	0.267**	0.385**	1.00			
Search	121	1	2.06	0.623	0.305**	0.296**	0.546**	1.00		
Collection	121	1	2.04	0.523	0.201*	0.277**	0.249**	0.427**	1.00	
Satisfaction Level	121	1	2.05	0.545	0.379**	0.362**	0.431**	0.580**	0.490**	1.00

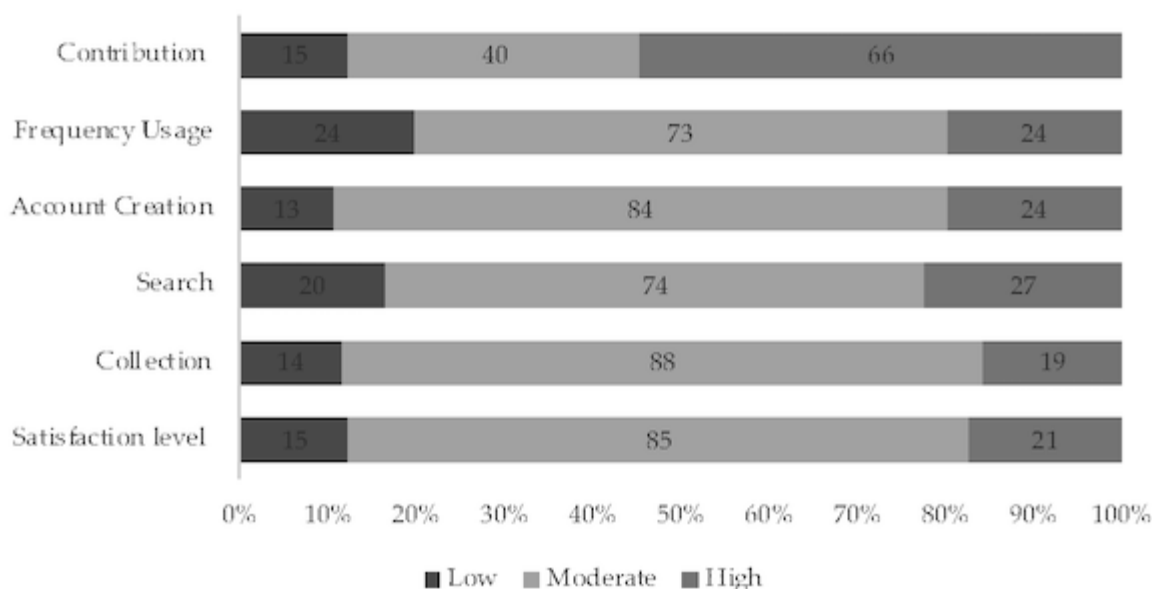
\*\* Significant correlation ( $p$ ) at the level  $\leq 0.01$ , \* Significant correlation ( $p$ ) at the level  $\leq 0.05$

[Figure 1](#) shows the distribution of 121 respondents' answers to questions related to SLs. The academic contribution variable and the ease of tracking variable are the two variables with the most positive answers. A total of 83 respondents gave positive answers to questions regarding the contribution of SLs in their academic activities, whereas 57 respondents gave positive answers when asked about the ease of conducting searches in SLs. The majority of answers for other variables are categorized as moderate or neutral answers. Questions regarding the completeness of the collection received the least positive answers, with only 37 respondents feeling that the SL collection was very complete.

**Figure 1:** The results of the shadow library variables.

[Figure 2](#) shows the distribution of 121 respondents' answers to questions related to OPAC UI. The variable that received the most positive answers is the academic contribution variable: 66 respondents gave positive answers when asked about the contribution made by OPAC UI to their academic activities. The majority of answers for other variables are categorized as moderate or neutral answers. Questions regarding the completeness of the collection received the least positive answers, with only 19 respondents feeling that the

SL collection was very complete. No OPAC UI variable received more positive answers than the corresponding variable for the SLs.



**Figure 2:** The results of the variables of the Universitas Indonesia Online Public Access Catalog.

The survey concluded with an open-ended query about students' apprehensions regarding the ethical and legal dimensions of sourcing reading materials from SLs. Among the 121 students who employed a shadow library, 42 indicated indifference towards the legality and potential copyright infringement of accessing collections through such means. They gave a variety of reasons for this indifference, including the lack of severe penalties for such usage, unawareness of its potential illegality, the belief that knowledge should be freely accessible to everyone without financial barriers, the superior efficiency of the SL site compared to OPAC UI, or the broader array of resources offered by the SL site. Some representative answers are as follows:

"No, because there are still few penalties for users of illegal reading materials in Indonesia." (ID 2, female, Social & Humanities Cluster, 2019)

"No, because at first I didn't know that it was illegal and the shadow library is sometimes very helpful in finding lecture reading material." (ID 102, male, Social & Humanities Cluster, 2019)

"No, because knowledge should be a public good and its access should not be limited only to those who have money." (ID 126, male, Social & Humanities Cluster, 2019)

"No, because it is more efficient in doing the task." (ID 138, male, Social & Humanities Cluster, 2022)

“No, because the legal Web site provided by UI itself does not provide complete reading material; sometimes when you need reading from a legal Web site, UI does not subscribe to the service, so you are forced to use the shadow library.” (ID 261, male, Science & Technology Cluster, 2019)

Meanwhile, 68 respondents answered that they care about the ethical and legal issues of using SLs, giving several different reasons, such as concern for copyright law, empathy for the authors of library materials, guilt, or fear of possible sanctions. However, some respondents felt that time and financial constraints forced them to continue using SLs despite these concerns. Some sample responses are as follows:

“I really care about this. However, such important scientific works must be protected by copyright. At least I use the sources from these sites wisely (include source, author, and paraphrase) so as not to plagiarize.” (ID 11, female, Social & Humanities Cluster, 2022)

“I acknowledge and agree that this is an illegal act because the shadow library is an unofficial site that does not have the right to publish reading sources. This, of course, will be detrimental to the author because his work can be accessed freely and does not consider the original ownership.” (ID 25, female, Social & Humanities Cluster, 2019)

“Yes, but assignments and economic limitations forced me to access through [the] shadow library.” (ID 179, male, Science & Technology Cluster, 2021)

“Yes, for fear of fines and copyrights.” (ID 231, female, Social & Humanities Cluster, 2019)

“Yeah, because [I] actually feel guilty for [them] being illegally obtained.” (ID 239, female, Social & Humanities Cluster, 2020)

In addition, some respondents gave a more neutral response:

“Yes, because I know being a writer, editor, and others who contribute to an article or research is hard. So, it would be better if we use and cite it using the official Web site so that the prestige of the research team rises. However, I’ve also heard rumors that official research collection sites, such as those subscribed to by OPAC UI, reap benefits that the research team turns out to be lacking. In fact, some say that researchers will freely provide their research and feel more happy if they are directly approached. So, it seems I am more neutral on this matter.” (ID 66, male, Health Sciences Cluster, 2020)

It can be concluded from the respondents’ answers to this open-ended question that the ethics of using SLs are still being debated among UI students.

## 5. Discussion

### 5.1. Main findings

The questionnaire results show that the number of respondents who do not use SLs is greater than the number of respondents who do: 141 (53.8 percent) of the respondents have not used SLs compared with 121 (46.2 percent) who have. The  $p$ -value analysis showed no significant relationship between SL use and gender ( $p = 0.436$ ). However, a significant relationship was found between SL use and class ( $p = 0.000$ ) and scientific background ( $p = 0.003$ ). Most respondents from the Social & Humanities and Health Sciences clusters are SL users, whereas only a minority of respondents from the Science & Technology and Vocational Education clusters use an SL.

The older respondents are also more likely to be SL users than younger students. The percentage of SL users increased from the 2022 class to the 2019 class, with only 22.7 percent of the 2022 class, 44.9 percent of the 2021 class, 64.7 percent of the 2020 class, and 83.3 percent of the 2019 class using an SL. The relationship between demographics and SL use has never been studied before in a university setting. These results suggest that knowledge about SLs is acquired while students are in college, and they become a resource that gradually becomes more important for students and is increasingly used over time.

Overall, Sci-Hub is the most frequently used SL, with 93 (35.5 percent) respondents using it. Z-Library is in second place with 80 (30.5 percent) users, and LibGen is the least used SL with only 45 (17.2 percent) users. These results align with the responses to the questions that asked respondents about their awareness of the status of these three sites as SLs: 105 (40.1 percent) respondents said they knew that Sci-Hub is an SL, followed by 86 (32.8 percent) who said they knew that Z-Library is an SL, and 66 (25.2 percent) who said they knew that LibGen is an SL.

The results also show that the number of respondents who use SLs is significantly smaller than the number who are aware of their existence. Only 93 respondents use Sci-Hub, though 105 of them are aware of its existence and that it is an SL. Likewise, 86 respondents know that Z-Library is SL, but only 80 of them use it, and 66 respondents are aware of LibGen's status as an SL, but only 45 of them use it. This may indicate that concerns about the legality of SLs can make student respondents more reluctant to use them and that some of them are satisfied with official alternatives, such as OPAC UI.

However, the results also show that respondents who have used SLs seem to prefer them over OPAC UI. From the descriptive analysis, it is evident that SLs score higher than OPAC UI in all variable assessments. SLs and OPAC UI received high scores in the contribution to academic activities variable. In particular, SLs have an average score of 2.64, whereas OPAC UI has an average score of 2.42. SLs received another high average score in the variable ease of browsing (2.38) compared to UI, which has a moderate score (2.06). Apart from these two variables, SLs always receive an average score above 2.20, whereas UI never receives an average score above 2.09. The variable of ease in conducting searches has the largest distance between scores for SLs and OPAC UI, with a distance of 0.32.

### 5.2. Implications of using shadow libraries at Universitas Indonesia

The findings of this research are in accordance with the results obtained by Mejia, *et al.* (2017), who surveyed Latin American students. Mejia, *et al.* concluded that the respondents who knew about Sci-Hub often found what they wanted using the database and that they used the site twice a month on average. More than half of the students who knew about Sci-Hub agreed that it contributed positively to research. However, most students were unaware of this resource, though it is a very useful tool, as it offers free access to a large number of research articles in scientific journals. Like Mejia, *et al.* (2017), this study also found that most respondents have not used SLs, but those who have used it recorded positive impressions.

The respondents had more positive impressions after using SLs compared with OPAC UI. Respondents



who use SLs report that they use them more often than OPAC UI, feel that they get a more positive contribution from SLs to their academic activities, feel that SLs are easier to access and use, and that SLs have a more complete and satisfying collection than OPAC UI.

Of all the questions asked, the most prominent aspect of SLs compared to OPAC UI is the ease of searching. The distance between the average score obtained by SLs (2.38) and OPAC UI (2.06) for this variable is the largest among all variables. This indicates that ease of searching is the most prominent advantage that SLs have over OPAC UI. This finding is also in accordance with the findings of Oakley (2016), who compared the process of searching for articles using SLs (Sci-Hub and LibGen) with OPAC UI. The results show that browsing library materials using SLs is faster. According to Faust (2016), the “click load” using Sci-Hub was much lower than going through the hospital online library he was used to, and this saved him significant time.

Faust (2016) also stated that the attractiveness of Sci-Hub is not only due to its speed but also its reliability. A search for articles or other reading materials through a hospital or university library does not always guarantee that the articles will be available to download: Users may instead find the dreaded “access request” hyperlink. In contrast, when Sci-Hub finds an article, users are always one click away from the PDF file they want. Reliability, as a factor, was also examined in this study, especially in the variables of ease of account creation/activation, ease of searching, and collection completeness. In all these aspects, SLs received a higher score than OPAC UI. It is possible that some respondents have not registered or been able to activate their UI Library account, so they are still unable to download special membership library materials provided by the UI Library.

The library certainly has a role in communicating the SL phenomenon to its users. According to González-Solar and Fernández-Marcial (2019), there seems to be no homogeneous communication model about SLs between libraries. This paper also provides several examples of how different libraries communicate the SL phenomenon to their users. Information about Sci-Hub has been disseminated by libraries at the University of Delaware, Kansas State University, Washington University in St. Louis, Bond University, and the University of Windsor. The Kansas State University Library manual page has a negative attitude toward Sci-Hub, stating that “This page explains why librarians disagree with the use of resources accessible from Sci-Hub.” [3] While Bond University Library has no clear stance, it does point out that using SLs is illegal and that users must comply with university regulations, which prohibit it. In contrast, the Cornell University Guide describes how to use Sci-Hub without publicly positioning itself for or against its use. Sci-Hub has also become the topic of several events, such as a talk entitled “Online piracy: Why Sci-Hub is disrupting scholarly publishing” at the Georgetown University Library. The UI Library could follow these examples and try to communicate the SL phenomenon to its users; it could also take the opportunity to qualitatively examine which incentives encourage users to choose SLs over OPAC UI. This could help the development of OPAC UI, which could be made more user-friendly based on feedback provided by students.

### **5.3. Limitations**

The process of data collection was constrained due to time restrictions and the ongoing COVID-19 pandemic. With a data collection timeframe of only a month, the yielded results may not be fully representative. The respondents for this study were solely undergraduate students, excluding other users of OPAC UI such as faculty members and postgraduate students. The employment of questionnaire services and a convenience sampling approach also poses a limit to the study’s representativeness. Without direct interviews with respondents, detailed explanations regarding their responses could not be procured. Additionally, the reliance on recall-based instruments may not accurately reflect whether students remember the specific site where they located an article during their online search.

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## **6. Conclusions**


This research shows that the majority of UI students have not used SLs; however, those who have used them have more positive impressions and higher satisfaction after using it compared with OPAC UI. The survey results show that positive impressions and satisfaction are driven by the superiority of SLs over OPAC UI in terms of their contribution to academic activities, ease of account creation/activation, ease of browsing, and collection completeness. Student answers to an open-ended question indicated that they have misgivings about the ethics of using SLs, with the majority expressing concerns. However, time and financial constraints and the ease of use of SLs incentivize their use. This study can be used as a starting point for further research on the use of SLs in Indonesia, which could use more heterogeneous samples, more data collection/processing time, and in-depth interviews.

The use of SLs cannot be recommended because of the large number of library materials that they provide illegally, which causes losses to publishers and authors. However, their use by students is difficult to control and understand due to the multitude of obstacles they face when using the digital facilities of their university's official library. Therefore, it is important to study which incentives encourage people to choose an alternative to SLs and what makes them prefer SLs over the digital facilities of their institution's official library. Such research could help university libraries, as well as other institutions, to study their users' information-seeking behavior and improve the quality of their digital facilities so that the need for, and incentives to use, SLs decrease among researchers, students, and other digital-library users.

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## 7. Suggestions

This research is expected to help the UI Library communicate with students regarding the SL phenomenon and receive input from students to enable improvements to the ease of use of OPAC UI. The UI Library needs to pay attention to whether there are deficiencies that need to be addressed in their digital library or whether UI students are unable to make optimal use of available online facilities. This can be achieved by increasing communication with students regarding their experiences of using OPAC UI and other digital-library facilities that have been provided.

In fact, the UI Library itself has conducted regular surveys to measure UI student satisfaction, entitled "Survey on utilization of electronic learning resources (online database commercials) of the UI academic community". The survey was sent via e-mail, providing information on various online databases that library members could use and how to access them. It would be useful to research how many students know about the existence of this survey and are survey respondents as well as whether the survey results are representative of how students feel. Their answers could give the library information about what needs to be done next. If student complaints show weaknesses and deficiencies that exist in OPAC UI, then improvements need to be made. For example, if student complaints indicate that they lack knowledge on how to optimally use the UI Library's digital facilities, then it would be necessary to increase the effectiveness of communication about the UI Library and how to use all of its facilities, such as when students are undergoing a learning orientation period. 

### About the authors

**Fauzan Eka Kusuma** is an undergraduate student at at Universitas Indonesia.

E-mail: fauzan [dot] eka91 [at] ui [dot] ac [dot] id

**Rahmi Rahmi** is an assistant professor in the Department of Library and Information Science at Universitas Indonesia.

E-mail: rahmi [dot] ami [at] ui [dot] ac [dot] id

## Acknowledgments

The authors thank Universitas Indonesia for funding this research through PUTI Q2 with contract number NKB-1202/UN2.RST/HKP.05.00/2022. Any opinions, findings, and conclusions described here are of the authors and do not necessarily reflect those of the sponsors.

## Notes

1. Hartono, 2017, p. 77.

2. Hartono, 2017, p. 78.

3. <https://guides.lib.k-state.edu/c.php?g=645013&p=4520198>.

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## **Appendix**

### **Demographic information**

Initials/Name

Sex

Department

Course of study

Year of study

**Principal Questions****Classification**

Do you utilize this website?	Yes	No
<i>SciHub</i>		
<i>Library Genesis</i>		
<i>Z-Library</i>		

Were you aware that this website is a shadow library?	Yes	No
<i>SciHub</i>		
<i>Library Genesis</i>		
<i>Z-Library</i>		

**Contribution**

	Yes	Neutral	No
Positive impact on your coursework from using shadow libraries (for instance, SciHub, Library Genesis, Z-Library)			
Positive impact on your coursework from using the OPAC of the UI Library			

**Usage Frequency**

	Never	Sometimes	Always
How often do you use shadow libraries (eg SciHub, Library Genesis, Z-Library) when looking for library materials?			
How often do you use the UI Library OPAC when looking for library materials?			

**Accessibility**

	Not easy	Quite easy	Very easy
How easy do you think it is to create an account in a shadow library (eg SciHub, Library Genesis, Z-Library)?			
How easy is it to create an account at the UI Library OPAC?			
How easy do you think it is to search the shadow library?			
How easy is it to search the UI Library OPAC?			

**Collection**

	Incomplete	Quite complete	Very complete
How complete are the collections in the shadow library (eg SciHub, Library Genesis, Z-Library)?			
How complete is the collection in the UI Library OPAC?			

**Satisfaction Level**

	Dissatisfied	Quite satisfied	Very satisfied
What is your level of satisfaction after using shadow libraries (eg SciHub, Library Genesis, Z-Library)			
What is your level of satisfaction after utilizing the UI Library OPAC			

Do you care if accessing collections via shadow libraries (like SciHub, Library Genesis, Z-Library) is illegal and infringes copyright? If YES/NO, please explain why.

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### Editorial history

Received 10 February 2023; revised 2 June 2023; accepted 27 September 2023.

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The use of shadow libraries at Universitas Indonesia  
by Fauzan Eka Kusuma and Rahmi Rahmi.  
*First Monday*, volume 28, number 10 (October 2023).  
doi: <https://dx.doi.org/10.5210/fm.v28i10.12947>