



Open access information resources and university libraries: Analysis of perceived awareness, challenges, and opportunities

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ABSTRACT

This study assesses the perceived level of Open Access (OA) awareness, challenges, and opportunities in context of university libraries of Pakistan. The differences between public and private sector university libraries in terms of their awareness, challenges and opportunities were also analyzed in this study. Survey research design, based on a structured questionnaire, was employed to meet the objectives of the study. The population of the study was libraries of Higher Education Commission of Pakistan (HEC) recognized universities located in Punjab and Islamabad (Pakistan). The findings revealed that majority of university libraries were *fully aware* of HEC-National Digital Library (NDL) OA resources, OA journals, and Pakistan Research Repository, whereas, *somewhat aware* of Budapest OA Initiative, and Diamond OA Model. Lack of additional resources (staff, time, efforts), unreliability of OA information resources, and inadequate tools and infrastructure were identified as top challenges. However, free access, increase in library value, and fulfilling users need with shrinking budget were top three identified opportunities. The study did not find any significant statistically difference between public and private university libraries in terms of their level of awareness, perceived challenges and opportunities. This study is administered in institutional context and fills the literature gap.

Introduction

Over the last three decades, developments in Information Communication Technologies (ICTs) have brought a revolutionary change in social communication patterns and information behavior. The digital revolution has not only changed the scholarly communication patterns but also resulted in a vast amount of scholarly literature such as books, theses, journals, reports, research articles, working papers, etc. (Alam, 2014; Kaba & Said, 2015; Van Trier, 2009). This vast amount of information, which is now available on the internet in digital form, has increased the issues of access and preservation. The high subscription cost and strict licensing conditions of serial publications have increased the issues for libraries to provide ideal and rich collection to their users within low budgets (Pinfield, 2013). In this scenario Open Access (OA) has appeared as a prerequisite for libraries to survive and thrive in this critical condition (Giarlo, 2005; Pimm, 2014).

Emergence of OA initiatives in scholarly communication has grown significantly, which has transformed the traditional scholarly communication environment to a free scholarly communication environment and resulted in increased number of OA journals and research articles

(Alam, 2014; Kaba & Said, 2015; Schmidt et al., 2005; Van Trier, 2009). This transformation in scholarly communication affected academic libraries in many ways, particularly in the provision of scholarly communication. For the provision of scholarly information to the users, libraries play different roles including collection development, providing advice on information access, managing subscriptions budgets, managing institutional collection, and reporting on usage of resources and services. The abundance and free access of OA resources significantly alter the methods of how libraries were dealing with the traditional information resources. Harris (2012) noted that the roles remained important but shift in emphasis and the way they are carried out.

OA is not a new concept; the term has different meaning for different communities (Mavodza, 2013). The official start of OA was in 2002 with the release of "Budapest Open Access Initiative" (BOAI). BOAI defines OA as:

By 'open access' to this literature we mean immediate, free availability of the literature on the public internet and permitting any user to read, download, copy, distribute, print, search, or link to the full

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text of the articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and only role for the copyright in this domain, should be to give authors control over the integrity of their work and right to be properly acknowledged and cited.

(“Budapest Open Access Initiative,” 2002)

After the BOAI, two more influential statements, the “Bethesda Statement” and the “Berlin Declaration,” came into public in 2003 and have been widely accepted by OA proponents for advocating restriction-free, immediate access to scholarly literature that is available for everyone on the public internet. The Berlin Declaration and Bethesda Statement define a work as OA if the copyright holder allows the user to: “copy, use, distribute, transmit and display the work publicly and to make and distribute derivative works, in any digital medium for any responsible purpose, subject to proper attribution of authorship” (Berlin, 2003; Bethesda, 2003).

Moreover, there are two main strategies to achieve OA: Gold OA and Green OA (Holley, 2019; Zhang & Watson, 2017). Gold OA refers to publications in OA journals, that are scholarly, in digital form, and freely available to the users. In contrast Green OA involves self-archiving, where author deposits their refereed articles from traditional journals in institutional or subject-based repositories. Every journal publisher has different policies for authors that allows them which version of the article (preprint, post print, PDF) they can self-archive (Björk, 2017; Björk et al., 2014; Grabowsky, 2015; Springer, 2019; Suber, 2015).

For the last few years, publication of scholarly literature has been multiplying at a rapid pace. Due to this growing number of scholarly publications and their escalating prices, it is almost impossible for libraries to subscribe to an ideal number of journals for their users. To cope with this situation, libraries are adopting alternative strategies such as: unsubscribing to journals subscriptions, transferring books budget to journals subscriptions, or involving in other kind of licensing solutions (Gadd & Troll Covey, 2019; Swan, 2006). In this critical situation, OA has appeared as a sanctuary for libraries that not only solves pricing crises but also solves permission barriers to scholarly literature (Giarlo, 2005; Suber, 2015). By adopting OA advocacy, libraries gain budgetary relief from costly journals and increase their library value by providing free access to scholarly literature as well (Mullen, 2011). In Pakistan Gold OA showed a significant growth whereas the progress of Green OA was relatively slow (Qutab, 2008; Sheikh, 2017, 2020). The reasons behind the slow development of Green OA were lack of government support, and negligence from educational institutions, library associations, and libraries and funding bodies (Sheikh, 2020).

The importance of OA cannot be overlooked by libraries. OA has been the topic of research and several empirical studies have been conducted to assess the awareness level and involvement of different communities in OA initiatives, however, the studies on OA in libraries’ perspective, particularly in organizational context, show scarcity in Pakistan. Hence, there was a need to assess the awareness level of OA among university libraries along with identification of perceived challenges and opportunities posed by OA to university libraries.

Literature review

The literature review provides insight into the purpose of the study, awareness of OA in different communities, challenges related to OA information resources and opportunities that OA offers to different communities. Different databases, such as Google Scholar, LISTA, Science Direct, Emerald Insight, and JSTOR were searched for the relevant literature. The terms used for literature search were: open access, open access and libraries, awareness of open access, open access challenges, open access barriers, open access Pakistan. The researcher accessed most

of the literature within university campus by using university subscribed databases.

Literature shows that libraries and librarians have positive attitudes toward OA. Palmer et al. (2009) found that academic librarians of United States of America at large had positive attitudes toward OA principles and focused on advocating OA. In 2011, almost half of the scholarly publications of academic librarians were available through OA, which was higher than the rate of articles published OA by LIS authors at that time (Mercer, 2011). Peekhaus and Proferes (2015) reported that LIS faculty members of North America that have more knowledge about institutional repositories, subject-based repositories and OA journals, have less reservations about the quality of OA journals and consider that OA journals are cited more heavily than traditional subscription-based journals. The findings of the study also revealed that 80% of the respondents had submitted their manuscripts or had published their articles in subscription-based journals 1 year before the survey, whereas only 37% had done the same thing in OA journal. A similar situation was reported from Nigeria by Bolarinwa and Utulu (2011) who identified that academic librarians of Nigerian private universities had positive perception toward OA publishing, however their level of involvement in creating awareness of OA was very low.

Baro and Eze (2017) analyzed different factors that academic librarians of Nigeria considered while selecting OA journals for publications. The findings of the study revealed that the majority of the academic librarians were aware of Gold and Green OA models but not aware of Diamond OA model. Furthermore, the majority of the academic librarians were not or little aware of their institutional repositories, while few of them self-archive their publications using institutional repository and ResearchGate.

Kassahun and Nsala (2015) conducted a study to determine the awareness level of academic librarians of Botswana toward OA information resources to support reference services. The study found that 67% academic librarians of private institutions were not aware of OA concept. The study also identified major challenges in promoting OA resources as lack of coordination between faculty and library administration, inadequate infrastructure or incompatible library management system for management of OA information resources.

Qutab (2008) conducted the first and foremost study to analyze the status of OA movement in Pakistan. The findings of the study revealed that OA movement in Pakistan was started on the institutional and personal levels. It was also revealed from the findings that the Gold OA movement in Pakistan was growing at a rapid pace, whereas the development of Green OA movement was slow. The reason behind the slow growth of Green OA movement was lack of support by the Government for OA advocacy. The study also identified that Pakistani literature like newspapers, medical journals, Urdu poetry and literature, and writings related to Islam was freely available on the public internet. The study emphasized the government role to promote OA movement at national level.

Sheikh (2017) surveyed faculty members of Islamabad (Pakistan) to assess their awareness level, attitudes and use of OA scholarly publication. It was revealed from the findings that majority of the faculty members (71.5%) were aware of OA whereas their awareness level of OA information resources and initiatives was very low. Faculty showed very positive attitude toward OA in all contexts. Another fact was revealed from the findings that majority of the faculty members used OA resources frequently but few of them published their own research papers in OA journals. The reason behind the low publication rate in OA venues was low awareness level of OA publication venues and article processing charges (APCs) that is charged by publisher to publish in OA journals.

A recent study (Sheikh, 2020) identified 201 Higher Education Commission (HEC) of Pakistan’s recognized OA Pakistani journals and revealed the rapid development of Gold OA in Pakistan. The study emphasized the development of OA policies, institutional repositories, and promoting OA publications. DOAJ indexed 75 Pakistani OA journals

("Directory of Open Access Journals," 2020). Moreover, four institutional repositories including the Pakistan Research Repository were indexed in ROAR and Open DOAR ("OpenDOAR," 2020; "Registry of Open Access Repositories," 2020).

Veena (2016) assessed university students awareness level and extent of usage of OA information resources. The study also identified problems faced by university students for accessing OA information resources. It was found from the study that majority of the students were aware of OA information resources. Furthermore, students faced problem of slow internet speed, difficulty in finding relevant information and poor computer literacy skills in accessing OA information resources. Ease of access and free of charge access were identified as advantages of OA by the respondents.

Jain (2012) reported in her study that developing countries left behind in achieving full potential of OA. The reason behind are various challenges and barriers toward OA such as: poor telecommunication infrastructure, high cost of ICTs, poor ICT infrastructure for maintaining sustainable institutional repositories, low awareness level and misconceptions of OA, and difficulty in managing intellectual copyrights through alternative publishing agreements.

In spite of these challenges, OA also offers a lot of benefits to different communities such as: increase the visibility of the research work and citation rate, provide barrier-free access to latest literature, solves pricing and permission crisis for scholarly journals, and journals and publishers are also taking advantages of OA by making their articles more visible, discoverable and retrievable (Suber, 2010). The reviewed literature establishes that there have been several studies carried out worldwide on the various aspects of OA, however, the literature presents a gap in this area of importance in local context. Thus, this potential gap in the literature has motivated the researcher to explore this topic in library context in Pakistan.

Objectives of the study

The objectives of the study were to:

1. Assess the level of OA awareness in university libraries
2. Identify perceived challenges posed by OA to university libraries
3. Identify perceived opportunities posed by OA to university libraries
4. Compare the level of difference between public and private universities libraries in term of their awareness, perceived challenges and opportunities

Research hypothesis

To investigate the 4th objective of the study following null hypothesis was developed:

HO1. There is no statistically significant difference between public and private sector university libraries in terms of OA awareness, perceived OA challenges, and OA opportunities.

Research methodology

The data presented here is the subset of an M.Phil. research thesis. The study was quantitative and a Web-based survey questionnaire was used for data collection. The population of the study was consisted of 88 university libraries of Higher Education Commission (HEC) recognized universities that were located in two regions of the Punjab and Islamabad Capital Territory (ICT). These two regions house the 114 million masses (Punjab = 111 millions; ICT = 3 millions) (Pakistan Bureau of Statistics, 2017). A census survey was conducted due to the limited size of the population and all 88 university libraries that were located in the Punjab province and ICT were approached to respond the study. The study received 57 responses with response rate of 64.7%. This study is

administered in institutional context and fills the literature gap and findings may be generalized to Pakistan as well as other developing countries having similar socio-economic landscape, such as South Asian countries. The study has theoretical implications for LIS researchers and practical implications for library schools, university library administration, library associations, and policy making institutions of higher education. The findings will help the libraries and university administration to address the identified challenges by improving awareness and cultivate opportunities by addressing identified challenges.

Data collection instrument

A thorough study of the previous published literature on the topic of OA awareness, challenges and opportunities related to OA was done for the questionnaire development of the study. There was no such study available that covers the libraries' perspective of awareness related to OA, OA challenges and opportunities. The non-availability of the required literature was a biggest challenge for the researcher in the development of the questionnaire. However, the researcher got some help from the study of Sheikh (2017) for the development of the section of OA awareness of the questionnaire, Furthermore, for the development of section of challenges, the studies of Charles and Bailey (2007) and Schmidt et al. (2005) were consulted. Peter Suber the champion of the OA has describes lots of benefits of OA in his various studies. Therefore, the study of Suber (2010) was consulted for the development of the section of OA opportunities in the questionnaire.

There were overall 33 questionnaire items in the questionnaire that were framed on 4- and 5- point Likert type scales for the response of the respondent libraries. The validity of the questionnaire was checked by six experts of the field. The experts were selected purposely on the basis of their experience, career, and research background. The experts also represented public and private sector university libraries. On the basis of the experts' review, some statements were added to the questionnaire and pilot testing was conducted. A group of 15 departmental libraries of university libraries participated in pilot testing. The researcher (first author) self-administered the pilot study and briefed the participants about the questionnaire. However, on the basis of feedback of experts and the participants of pilot testing, it was evident that most of the respondents were unable to differentiate in two terms i.e. "slightly aware" and "somewhat aware", which were used in Likert-type scale for awareness section. The feedback of participants of pilot study, particularly, showed that these two options are overlapping. Therefore, the option of "slightly aware" was removed and the 5-point Likert type scale (1 = Not aware, 2 = Slightly aware, 3 = Somewhat aware, 4 = Moderately aware, 5 = Fully aware) was converted to 4-point Likert type scale (1 = Not aware, 2 = Somewhat aware, 3 = Moderately aware, 4 = Fully aware) in awareness section. Moreover, the population of this study was geographically dispersed, and it was impossible for the researchers to personally approach the participants of the study and brief them about the scale. Thus, the conversion of 5-point Likert type scale to 4-point Likert type scale was made to avoid the ambiguity on respondents' end.

After addressing the validity by experts' feedback and pilot testing, the questionnaire was administered through emails, post, and in person by the first author. Follow-up calls and emails were sent to maximize the response rate. The collected data was analyzed by using Statistical Package for the Social Sciences (SPSS) version 23 and descriptive and inferential statistics was applied to make the inferences. The Cronbach's alpha value of each section (Table 1) shows that the data collection instrument was reliable to measure the phenomena. The values of reliability coefficient shows that reliability and internal consistency of questionnaire items on OA awareness ($\alpha = 0.904$) and OA Challenges ($\alpha = 0.906$) were very good and of OA opportunities ($\alpha = 0.633$) was satisfactory as Nunnally and Bernstein (1994) consider that 0.6 and above Cronbach value means that the instrument is reliable enough to measure the phenomena.

Table 1
Results of Cronbach's alpha.

Sr. #	Scale (OA)	Cronbach's alpha	Number of statement
1	Awareness of OA	0.904	15
2	Challenges posed by OA information resources to library	0.906	10
3	Opportunities posed by OA information resources to library	0.633	8

Data analysis and discussion

The participants

The population of the study was the university libraries of HEC recognized universities located in Punjab and Islamabad. A web-based questionnaire was distributed among 88 university libraries in which 57 were returned with response rate of 64.7%. Among 57 responding university libraries, 33 (58%) were public sector and 24 (42%) belonged to private sector (Fig. 1).

To investigate the awareness level of the university libraries about OA, the researcher asked a set of fifteen statement about OA terms, resources and initiatives from the respondents on four-point Likert type scale ranging from "Not Aware = 1" to "Fully Aware = 4". In order to determine the level of awareness of the respondents, descriptive statistics were applied and mean scores and standard deviations of the responses were calculated.

Results shows that respondents were *fully aware* of HEC digital library OA resources (M = 3.81), Open Access journals (M = 3.65), Pakistan Research Repository (M = 3.65), and Directory of Open Access Journal (DOAJ) (M = 3.56), while most of the respondents were *somewhat aware* of Diamond Open Access Model (M = 2.44) and Budapest OA initiative (M = 2.23) (see Table 2).

The results are aligned with a study that was conducted in Capital Territory of Pakistan (Islamabad), where most of the faculty members were aware of OA journals and Directory of Open Access Journals (DOAJ), while less aware of Gold and Green OA models and Budapest Open Access Initiative (Sheikh, 2017). These results are also consistent with the findings of Ajibili and Emmanuel (2017) who reported Directory of Open Access Journal (DOAJ) as a highly known source among private university libraries' students. However, these results contradict with the findings of Kassahun and Nsala (2015), who noted that majority of academic librarians (67%) were not aware of OA concept. The reasons may be geographical context and the time span of five years as the study of Kassahun and Nsala was conducted in Botswana in 2015.

The mean score of the statements about Gold, Green and Diamond OA models although showed that respondent libraries were *somewhat* aware, which shows the need for the library associations to work for the improvement of these models. Moreover, the mean score of Black OA

Table 2

Mean distribution of level of the awareness of OA terms, resources and initiatives.

OA terms, resources and initiatives	Mean	Standard deviation
HEC digital library OA resources	3.81	0.581
Open Access journals	3.65	0.612
Pakistan Research Repository	3.65	0.767
Directory of Open Access Journals (DOAJ)	3.56	0.802
Self-archiving (institutional repository)	3.46	0.781
Open Access Theses and Dissertations (OATD)	3.46	0.867
Black OA (Sci-hub, Lib-gen)	3.42	1.051
Registry of Open Access Repositories (ROAR)	3.26	0.992
Directory of Open Access Books (DOAB)	3.26	0.856
Networked Digital Library of Theses and Dissertations (NDLTD)	3.25	0.786
Open Access Subject Repositories	3.16	0.902
Gold Open Access Model	2.67	0.970
Green Open Access Model	2.61	0.996
Diamond Open Access Model	2.44	1.018
Budapest OA initiative	2.23	1.053

Note: 1 = Not Aware, 2 = Somewhat Aware, 3 = Moderately Aware, 4 = Fully Aware.

(Sci-hub, Lib-gen) awareness is higher than other OA models (Gold, Green, Diamond). The reason may be because libraries in Pakistan use Black OA resources (Sci-hub, Lib-gen) at large to get the information that is not available through OA and Higher Education Commission of Pakistan's National Digital Library (HEC-NDL) resources. HEC-NDL (n.d.) is the flagship project of Higher Education Commission of Pakistan initiated in 2002 for the provision of information in research and higher education institutions and make available some of the best commercial databases of scholarly contents to the user in tertiary education institutions. However, these resources are accessible in public sector institutions and libraries in private sector institutions don't have access to these resources. Moreover, these resources offer campus wide access and off campus access to HEC-NDL resources is offered by very few institutions (Rafiq et al., 2021). Thus, the non-availability of HEC-NDL resources hinder the information access and many of university libraries use rely on information resources available through black OA.

Challenges of OA

To meet the second objective of the study respondents were asked to identify the challenges associated with OA resources that their libraries face. Ten challenges mentioned in the literature were given to the respondents to rank on five-point Likert type scale ranged from "Strongly Disagree = 1" to "Strongly Agree 5".

The mean values of the statements (Table 3) shows that all respondents were neutral about the challenges. Therefore, frequency and percentage of agreements and disagreements on the statements were further calculated in order to identify major challenges. The data (Table 3) revealed that among 57 participant libraries, 33 (68%) agreed that lack of additional resources is a top challenge, inadequate tools and infrastructure was identify as a second major challenge by 32 (56%) participants, whereas 31 (54%) participants considered tracking change of OA information resources as a third major challenge that libraries face in terms of OA information resources.

Twenty-eight (45%) libraries were agreed on low speed of internet as a major challenge related to OA. While, 27 (47%) libraries indicated that incomplete/inaccurate metadata of OA information resources and unreliability of OA information resources as a challenge for them. Bullock et al. (2015) have also categorize incomplete/inaccurate metadata of OA information resources as a major challenge in management of OA resources.

The results (Table 3) further disclosed that among 57 libraries, 25 (44%) libraries considered the monitoring of availability of OA resources as a major challenge while 19 (33%) were neutral about it and

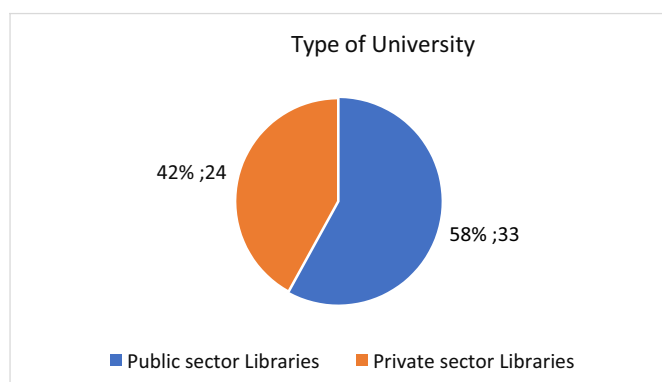


Fig. 1. Type of university libraries OA awareness.

Table 3

Frequency and mean distribution of challenges posed by OA to university libraries.

Challenges	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	4 Freq. (%)	5 Freq. (%)	Mean	Standard deviation
Lack of additional resources (staff, time, effort) for integration of OA resources in library collection	5 (9)	8 (14)	11 (19)	24 (42)	9 (16)	3.42	1.179
Inadequate tools, infrastructure to integrate OA information resources in library OPAC	4 (7)	8 (14)	13 (23)	26 (46)	6 (10)	3.39	1.082
Difficult to track change in dynamic OA information resources	4 (7)	6 (10)	16 (28)	27 (47)	4 (7)	3.37	1.011
Low speed of internet causes the inaccessibility of OA resources	3 (5)	13 (23)	13 (23)	22 (39)	6 (10)	3.26	1.094
Unreliability of OA information resources	2 (3)	9 (16)	19 (33)	19 (33)	8 (14)	3.39	1.031
Incomplete/Inaccurate metadata of OA information resources	6 (10)	4 (7)	20 (35)	24 (42)	3 (5)	3.25	1.040
Difficult to monitor the availability of OA resources as library has no specific relationship with suppliers or publisher	4 (7)	9 (16)	19 (33)	18 (37)	7 (12)	3.26	1.094
Lack of skills that are required for the integration of OA information resources to library collection	6 (11)	16 (28)	11 (19)	18 (32)	6 (11)	3.04	1.210
Low awareness of librarians and staff about OA	9 (16)	17 (30)	10 (17)	14 (25)	7 (12)	2.88	1.297
Low computer literacy skills of librarians and staff	4 (7)	22 (39)	12 (21)	12 (21)	7 (12)	2.93	1.178

Note: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

13 (23%) libraries did not consider it a challenge. Twenty-four (42%) libraries were agreed that lack of skills for integration of OA resources as a challenge for them, while 11 (19%) were neutral and 22 (39%) libraries were disagreed on it. Moreover, low awareness of librarians and staff about OA and low computer literacy skills were not considered a challenge by the majority of respondent libraries.

Insufficient additional resources (staff, time, effort), Inadequate tools, infrastructure to integrate OA information resources in library OPAC, and inadequate tools and infrastructure were identified as major challenges posed by OA information resources to university libraries. The findings are similar to [Veena \(2016\)](#) [Kassahun and Nsala \(2015\)](#) who identified lack of infrastructure or incompatible library management system is a challenge for the management of OA information resources.

Integration of OA resources in library's OPAC is necessary to offer one stop search through a single interface. This is the area where university libraries of Pakistan particularly and of developing countries generally lack. The absence of one-stop access to all library resources is a major challenge to offer the user a coherent experience of information retrieval through library system interface. The integration of OA resources through library's OPAC requires the staff time, skills, and able infrastructure. However, these requisites are inadequate as these aspects were considered top identified challenges.

Opportunities related to OA

Respondents were asked to identify the opportunities that OA information resources offer to their library. A five-point Likert type scale ranged from "strongly disagree" to "strongly agree" was used to assess the opportunities offers by OA information resources to the university

Table 4

Mean distribution of opportunities posed by OA to university libraries.

Opportunities	Mean	Standard deviation
Free access of OA information resources	4.47	0.758
Increase library value by providing maximum access to information	4.37	0.816
Helps to fulfill users need with in shrinking budget	4.32	0.789
24/7 access to OA information resources	4.23	0.780
No permission barrier	4.07	1.015
Right to archive them forever without special permission or periodical payment	3.96	0.906
Solve the problem of serial crises	3.95	0.953
Help to reduce headache involved in negotiating electronic journals and database licensing	3.93	0.923

Note: Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5.

libraries.

The data ([Table 4](#)) shows that all mean values of the statements are in the range of 4. It means that the respondents were agreed with all given statements and consider that OA offers all these opportunities to the library, while top most opportunity as per mean score was free access of OA information resources ($M = 4.47$). The second highest scored opportunity was increase in library value by providing maximum access to information ($M = 4.37$). OA helps to fulfill user need in shrinking budget ($M = 4.32$) was perceived as third major opportunity by the respondents.

Other top opportunities as per mean values were 24/7 access to OA information resources ($M = 4.23$), no permission barrier ($M = 4.07$), right to archive them forever ($M = 3.96$), solve the problem of serial crises ($M = 3.95$) and reduce headache involved in negotiation of electronic journal and database licensing ($M = 3.93$).

The university libraries of south Asian countries share many similarities. University libraries of the region face similar problems such as insufficient organizational and infrastructural support, poor fiscal condition, financial constraints, inadequate trained and skilled manpower, etc ([Khan & Bhatti, 2012](#); [Shuva, 2012, 2014](#)) and fail to innovate at large ([Awais & Ameen, 2019](#)). These challenges limit the libraries' capacity to meet the users' expectations. However, OA resources offer remedies and enable them to play their role.

The findings of the study are similar to [Suber \(2015\)](#) who mentioned that OA not only removes price barriers but also remove permission barrier and provide restriction free access to information resources. Coping with serial crises and decreasing budgets of libraries, OA resources are very much valuable for Pakistani university libraries. Thus, the respondent libraries agreed with all eight opportunities presented to them in questionnaire.

Level of distinction between public and private sector university libraries in terms of OA awareness, perceived OA challenges and OA opportunities

H01 was developed to check the level of distinction in terms of perceived OA awareness, OA challenges and OA opportunities between public and private sector university libraries. To test this null hypothesis, three new variables were created in SPSS on the basis of total mean values of the OA awareness, OA challenges and OA opportunities. Independent sample t-test with alpha level of 0.05 was applied to determine the level of differences among public and private sector university libraries.

Results of Independent t-test ([Table 5](#)) presented large p -values (>0.05) of each variable. Which proves that the difference between public and private sector university libraries in term of awareness, challenges and opportunities is not significant. Hence, the null hypothesis **H01** is accepted.

Table 5

Difference in level of perceived OA awareness, OA challenges and OA opportunities based on university type.

	Public		Private		t-Test	
	Mean	Standard deviation	Mean	Standard deviation	T	P-value
Awareness of OA	3.2404	0.58664	3.1250	0.59962	0.727	0.471
Challenges of OA	3.2606	0.72927	3.1583	0.85257	0.487	0.628
Opportunities of OA	4.1288	0.75032	4.2083	0.59054	-0.431	0.668

P value = 0.05.

Conclusion and recommendations

University libraries were fully aware of HEC OA information resources, OA journals and Pakistan Research Repository but their awareness level about OA publishing models (Gold, Green, Diamond) is low. The study also revealed that university libraries were also less aware of Budapest Open Access Initiative (BOAI). Based on the above findings, it is strongly recommended that library schools and library associations should arrange seminars, workshops, conferences and continuous education programs on OA in order to improve and promote awareness about OA concept, terms, models, resources and tools among information professionals.

The findings also revealed that university libraries lack additional resources (staff, effort, time) and inadequate tools and infrastructure for integration of OA information resources into library collections. It is recommended that the Higher Education Commission of Pakistan, other policy institutions as well as parent intuitions should provide extra funds for libraries so they can be able to develop latest infrastructure and acquire latest tools that can help them in managing OA information resources effectively and efficiently.

University libraries are taking advantages of OA information resources which helps them to get free access of OA information resources, increase library value by providing maximum access to information and helps them to fulfill their users' information needs with limited budgets. The study did not find any statistically significant difference between public and private sector university libraries in terms of awareness, challenges and opportunities of OA information resources.

CRedit authorship contribution statement

Muhammad Rafiq: Conceptualization, Methodology, Supervision, Project Administration Writing-Reviewing, Editing, Revision of the manuscript. **Mussarat Sultan:** Introduction, Literature Review, Methodology, Data Collection, Data analysis, Visualization, Validation, Writing-Editing, Revising.

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