



Awareness, Perception and Adoption of Open-Source Software (OSS) and Open Access Resources (OARs) in University Libraries of Pakistan

Muhammad Waris Bhatti

Emerson University, Multan, Pakistan,
Minhaj University, Lahore
chief.librarian@eum.edu.pk

Muhammad Naushad Sabzwari

School of Library & Information Sciences
Minhaj University, Lahore - Pakistan
hod.lis@mul.edu.pk

Muhammad Tariq

Library Information Services,
Comsats University Islamabad, Lahore - Pakistan
tariqnajmi@cuiilahore.edu.pk

Abstract

Open-Source Software (OSS) and Open Access Resources (OARs) have revolutionized the libraries and information centers all over the world including Pakistan, especially university libraries are considered most advanced in terms of usage and adoption of emerging technologies. Therefore, the status of OSS and OARs in University Libraries of Pakistan were assessed in this study, moreover, the relationship between awareness as independent variable and perception as dependent variable of top tier of Library Professionals working in University Libraries of Pakistan were also determined. The adoption of OSS and OARs as moderator of the Awareness and Perception relationship was also assessed. The quantitative research design with cross sectional approach was used to address the objectives of the study. The survey method using structured questionnaire, containing Likert-scale questions / items and a demographic section, as research tool were applied to collect the data from the respondents such as Chief / Head / Director / Incharge Librarian or Institutional representative (focal person) of HEC Digital Library of Pakistan of each Degree Awarding Institution (DAI). The results of the study depict that respondents better aware with OSS and OARs have better perception about OSS and OARs. Similarly, the library professionals of universities who adopted OSS and OARs have better understanding about OSS and OARs. Hence, adoption moderates the relationship between awareness and perception of



respondents. The research also reveals that university libraries are needed to proactively work on adoption of OARs to enhance its offered, as well as, new services and practices.

Keywords

Open-Source Software, Open Access Resources, University Libraries, Library Professionals, Library Services.

Introduction

Information and Communication Technology (ICT) have revolutionized the education sector as well as academic libraries and learning resource centers. Now, the libraries operations, from acquisition to dissemination of material, are linked with information technology and the term smart libraries is being used for all well-equipped libraries who have adopted the emerging technologies. The role of OSS and OARs in this regard cannot be overemphasized. The current study explains the status of OSS and OARs in DAIs of Pakistan according to the viewpoints of the Chief / Head Librarians.

Open- Source can be easily shared with other people, tailored and exposed to everyone. The phrase of the software development was originally related to a particular style of constructing computer software. OS projects, products or initiatives accept and propagate the concepts of transparent, meritocracy, rapid prototyping, sharing, collaborative work, and community-based production (Khan & Shahzad, 2024). A social movement known as "Open Source" was started by computer programmers and advocates for decentralization, openness, and unfettered ("open") sharing of knowledge instead of secrecy and centralized control over creative work. Unlike the object code which is computer programming language instructions that can be compiled and executed on computers but are hard to read or edit by humans, the word source is used to refer to the human-readable source code of computer programs (Rascoussier, 2024).

Open-source software has the source code that can be checked, edited and improved. Computer users do not tend to see it even though it is a component of software. The software workings can be altered by computer programmers who are able to manipulate this code and alter its functions. By accessing the source code, one can develop or improve a specific program. Similarly, new features can be added or included in the software, or the part that always works incorrectly can be fixed (Nesbitt et al., 2024).



Some of the renowned Open-Source Software being used for different operations related to computers includes: Linux, Mozilla Firefox, Python, VLC media player, GIMP, LibreOffice, Blender, WordPress, Audacity, FileZilla, MySQL, PHP, Apache, Brave, GNU, GNU Compiler Collection, OpenOffice, Python, Shotcut, Mozilla Thunderbird, 7-Zip, BIND, BSD, Google (Tong, 2004). The most important OSS including Koha, DSpace, EPrints, Greenstone, Invenio, and FOLIO are all-encompassing solutions to automation of libraries, digital preservation, and open access distribution. They are very versatile, can be integrated with other systems and they are relatively inexpensive, thus they are specifically applicable in university libraries in Pakistan. The increasing use of these systems is an indicator of transition to open knowledge systems and sustainable library technology (Tahmoor Hussain, Hashmi, & Tariq, 2024).

Open Access (OA) term is used for those knowledge or information resources which are accessible to people freely, without any subscription fees or any other charges (Swan, 2012). The main reasons for open access is the description of Open Access as an application which is free, immediate, permanent, full-text, online and accessible, to maximize the uptake, usage, applications, and impact of an institutions output as an Information (Bawack & Nkolo, 2023). The Open Access Resources commonly fall under two categories; self-archiving (Green OA) and OA journals (Gold OA). The fact that these two types of resources can co-exist is due to the fact that both resources are not contradictory. In addition to that, the journals articles are available in green and gold paths to open access where the readers can access the articles free of charge. The extent of openness and rights of the users are identical in both types, but in the green and gold, the venues or delivery vehicles are unique. The paid open access can also be referred to as hybrid Open Access or hybrid route (Tariq, Mahmood, & Hameed-Ur-Rehman, 2015).

The biggest open access platforms are books, theses, journals, repositories such as Registry of Research Data Repositories (Re3data), Open Access Theses and Dissertations (OATD), Directory of Open Access Journals (DOAJ), Open Directory of Open Access Repositories (OpenDOAR), Registry of Open Access Repositories (ROAR), Directory of Open Access Books (DOAB) and Registry of Open Access Repository Mandates and Policies (ROARMAP) (Sheikh & Richardson, 2023).

Objectives

The following are the goals of the study:



1. To investigate the awareness of OSS and OARs in DAIs of Pakistan.
2. To uncover the Perception of OSS and OARs in DAI Libraries of Pakistan.
3. To examine the usage of OSS and OARs in DAI Libraries of Pakistan.

Hypotheses

Following are the hypotheses of the study:

1. H₁: Awareness and Perception of OSS and OARs are strongly correlated among university library professionals.
2. H₂: The use of OSS and OARs acts as a significant moderating variable in the relationship between awareness and perception among library professionals.

Literature Review

Many scholars have been carrying out research on Open-Source Software and Open Access Resources in relation to University Libraries both locally and internationally. The applicable literature is primarily downloaded via the internet.

Open-Source Software

A study carried out, using a survey approach, among the Librarians of the Public and Private sector Universities of Lahore by Hassan, Hamid, and Shah (2022) reveals that OSS needs very qualified employees compared to proprietary software. In addition, the research indicates that the lack of skills, technical support, lack of collaboration between administrators and employees and the absence of capacity building are some factors that cause a library not to implement OSS. Another study conducted by Tahmoor Hussain et al. (2024) concludes that OSS developers need to be trained and software ought to be able to provide better features like the feature of searching at advance level, library standards such as RDA, friendly interface and MARC21. Besides, allied documents of OSS must also be provided. The research makes a conclusion regarding proprietary software that they cost more than OSS installation and implementations.

Similarly, one of the studies carried out in Pakistan on the perception of Library professionals towards Open-Source Software explained the reasons of not much use of OSS such as the lack of technology, insufficient budget, expertise in IT, digital alienation of Librarians, and stakeholder engagement (Hussain & Rafiq, 2023). According to the research conducted by Kolawole and Oladokun (2021) regarding the implementation of Koha in HEIs in Nigeria, it was



found out that among the problems of this kind, one can distinguish the absence of institutional support, the absence of appropriate information, and librarian negative attitudes.

Open Access Resources

The study carried out by Pakistani LIS researchers Sultan and Rafiq (2021) has shown that DAIs Libraries are fully aware of the OARs such as HEC-NDLP OARs, OA journals, and PRR; conversely, they are not aware of the Budapest OA Initiative and Diamond OA Model. Among the challenges that have been noted by the researchers are the necessity of extra resources such as staffing, time, efforts, and so on, the absence of infrastructure, lack of sufficient tools and unpredictability of such information resources. Equally, the need of the hour has also been detected to be seminars, trainings, conferences, workshops and continuing skill programs on Open Access with the aim of enhancing and creating awareness on the resources, terms, concepts, models, and tools of Open Access to libraries, resource centers and information professionals.

Another study conducted by the researchers of Northern India examined on the concept of awareness on the OA Resources, as most of the researchers out of 814 who responded to the UTAUT theory. They were however not used extensively. The research also established that the copyright laws are perceived to be obstacles to the use of these resources. Additionally, the research has also focused on policy development and more awareness creation in order to promote the use of OA resources and information sharing (Zia & Nazim, 2023). The systematical literature study done in Pakistan shows that Open Education Resources (OERs) have four positive effects; Access to knowledge, support of lifelong learning, teaching aid improvement, and learning outcomes of students. Conversely, there are certain difficulties related to the use of OERs, such as time, awareness concerning OERs, copyright concerns, and technological and quality-related problems of OERs (Adil, Ali, Sultan, Ashiq, & Rafiq, 2024)

Theoretical and Conceptual Framework

This paper on OSS and OARs in University Libraries of Pakistan is based on three interrelated theories, explaining the uptake, use, dissemination and knowledge impact of OSS and OARs in higher education libraries:

1. Knowledge Management Theory (KMT)
2. Diffusion of Innovation Theory (DOI)
3. Information Society Theory (IST)



The model of this study takes the following assumptions:

- The organizational mechanisms in the OSS and OARs management and generation of actionable knowledge, as explained by KMT, are described.
- In this study, innovations will be discussed and explained with the help of DOI theory as to how the innovations are adopted and integrated in various university settings by library professionals.
- Information Society Theory situates the OSS and OARs adoption in a broader transformation of society towards knowledge-based development and digital inclusion and upon equity of access to information.
- Combination of these theories enable a researcher to:
 - Analyze how much things are perceived as questions of awareness to OSS and OARs among library professionals.
 - Analyze different patterns of OSS implementation in university libraries in Pakistan.
 - Understand the function and importance of OSS and OARs in Knowledge creation and sharing in the context of the global trends of Digital transformation.

Here in the below figure awareness to OSS and OARs of DAI library professionals is independent variable of the study and the dependent (outcome) variable is the perceptions / knowledge of such awareness. Adoption / Usage of OSS and OARs in University libraries of Pakistan is also investigated here as variable moderating the awareness and perception relationship, which could affect the strength of the relationship between awareness and perception / knowledge.

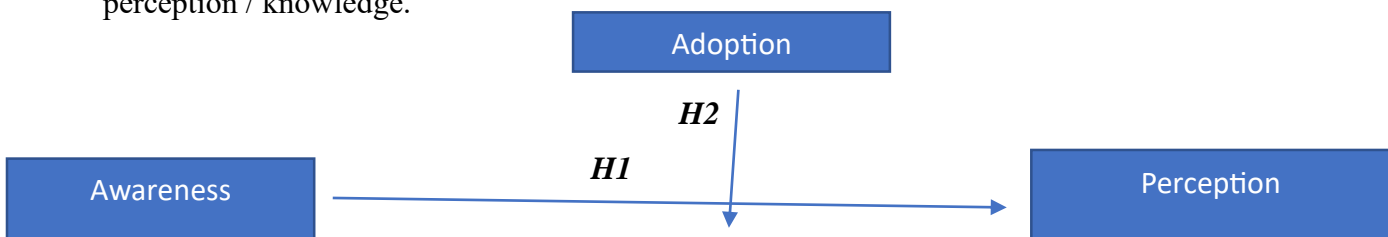


Figure 1. Status of OSS and OARs in DAI Libraries of Pakistan.



Methodology

The quantitative research design was used, which is part of the post-positivist paradigm because it involved quantitative measures of constructs that include awareness, perception and adoption towards OSS and OARs. Cross-sectional research design was used in the study which enabled the researcher to obtain data of a geographically spread population at a given point in time. The population of interest consisted of 270 university libraries found in Pakistan, and the unit of analysis was Chief Librarians, Library Heads, or the official office holder who is in charge of the digital library services.

A questionnaire was developed with a multifaceted literature review, pretested with a pilot study involving 15 people, and validated with the help of experts to guarantee content validity. The tool comprised of demographic questions and five-point Likert-scale questions that incorporated three major sections of awareness, perception and adoption of OSS and OARs. The questionnaire used 5-point Likert scale where 'strongly agree' was coded as '1' and 'strongly disagree' was coded as '5'. Likewise, in the case of awareness-based items 'extremely aware' was coded as '1' and 'not aware at all' was coded as '5'.

The reliability analysis also revealed that the internal consistency was excellent-to-good in all sections (Cronbach's alpha between 0.721 and 0.938) which validated the appropriateness of the instrument to be used in the further analysis. The self-administered online surveys were used in the data collection process, and they were supplemented by email, WhatsApp and telephone follow-ups following the ethical standards such as informed consent, confidentiality, and harm protection. The 221 complete responses obtained as a result of a census-oriented strategy were representative and reliable because they yielded an 81.85% response rate.

Results and Discussion

The section contains the discussion and explanation of the research on the data gathered on Open-Source Software (OSS) and Open Access Resources (OARs) in Pakistani university libraries and discussion on them according to set objectives of the study. The analysis and coding of the data were performed through the Statistical Package of Social Sciences (SPSS). Awareness, perception and adoption were described through statistics (descriptive). The tests of the hypotheses and finding of the relation and association between variables were executed by use of inferential statistics (correlation and regression analysis). There were 221 valid responses that were used in



the analysis, which was equivalent to a response rate of 81.85%, which is statistically significant to generalize.

Respondents' Demographic Profile

Respondents of the study was 221 professionals who participated in the survey where 161 (72.9%) and 60 (27.1%) of the respondents were males and females respectively. The participants of the survey were predominantly of the public universities, with the largest amount 128 (59%) being the representatives of this category. The respondents of the private institutions were 86 (38.9%), and a small proportion contained 7 respondents (3.2%), which belonged to semi government institutions. The age of the respondents was also all over with most of them coming in the range of 31-50 years. Namely, 85 participants (38.5) belonged to the age bracket 31-40 and 99 participants (44.8) belonged to the age bracket 41-50, which comprised more than 80% of the sample. A low percentage of the respondents fell between 51-60 (13.6%), with very few falling under 30 years (2.7%), and over 60 years (0.5%). The credentials of the respondents indicate that close to fifty percent of the respondents, 109 (49.3%), had a Master degree and 86 respondents (38.9) had an MPhil. Only a few, 26 people (11.8%), had a PhD.

Descriptive Statistics

Awareness about OSS and OARs

The descriptive statistics of awareness of OSS among respondents shows that people are familiar to different platforms of OSS in different ways. The awareness of KOHA was high as the mean result was 1.45 (on a 1 scale where 1 = Extremely aware and 5 = Not aware), indicating that the majority of respondents are quite familiar with this software. Descriptive statistics of awareness regarding Open Access Resources (OARs) among respondents show that on average, the participants are aware of popular resources, but their familiarity with them is not the same. The Pakistan Research Repository (PRR) and the DOAJ have the highest awareness with a mean score of 1.74 and 1.84 respectively, indicating that a majority of the respondents are quite aware with the two resources. Besides, respondents were aware of Black Open Access platforms (Sci-Hub, LibGen) also received a significant score (1.95 on average), which suggests moderate familiarity.

**Table 1:** *Descriptive Statistics of OSS and OARs Awareness (N = 221)*

Variable	Mean	SD	Variable	Mean	SD
Library Related OSS			Academic OARs		
KOHA	1.45	0.97	Pakistan Research Repository (PRR)	1.74	1.09
Evergreen ILS	2.87	1.35	DOAJ	1.84	1.12
OpenBiblio	3.20	1.26	OA Theses and Dissertations	2.09	1.18
NewGenLib	3.10	1.32	Black Open Access (Sci-Hub, LibGen)	1.95	1.33
BiblioteQ	3.53	1.21	Registry of Open Access Repositories (ROAR)	2.47	1.29
GitHub	3.31	1.31	Networked Digital Library of Theses and Dissertations (NDLTD)	2.20	1.31
DSpace	1.98	1.35	Open Access Subject Repositories	2.09	1.21
EPrints	3.15	1.45	Directory of Open Access Books	2.38	1.21
Fedora	2.74	1.40			
Greenstone	2.45	1.30			
Calibre	2.35	1.36			

Perception about Open-Source Software (OSS) and Open Access Resources (OAR)

Descriptive statistics on what the respondents think about the Open-Source Software (OSS) showed a general positive outlook on the subject of using it in DAI libraries. The willingness to use OSS amongst the participants was high with the mean of 1.68 and the general agreement was that OSS is effective in library operations (mean = 1.80) and is a cost-effective alternative to proprietary systems (mean = 1.86). Another aspect that respondents identified as promising by OSS are the ability to enhance employment (mean = 1.86) and its flexible nature (mean = 1.92).

The descriptive statistics of the perception of OARs used by the respondents shows that the respondents have a rather positive attitude towards the usage of the sources in their academic libraries, though certain worries were identified. Respondents were very willing to use OARs (mean = 1.67) and said that OARs are effective (mean = 1.70) and facilitate greater accessibility



of e-information (mean = 1.96). They also noted that OARs offer unrestricted access to the users (mean = 1.95) and they are well archived (mean = 2.02).

Table 2: *Descriptive Statistics of Perceptions Toward OSS and OARs in Academic Libraries (N = 221)*

Variable (OSS)	Mean	SD
Favorably willing to the usage of OSS in Academic Libraries	1.68	0.74
OSS are effective for academic libraries’ operations	1.80	0.78
OSS are the cheap alternatives to costly systems	1.86	0.89
OSS improve job opportunities	1.86	0.85
Library staff is competent enough to implement OSS	2.06	0.93
OSS is flexible to customize	1.92	0.75
Without vendor support, OSS depends on the developer community’s commitment	2.14	0.83
OSS are less user-friendly than commercial software	2.67	1.20
Variable (OARs)	Mean	SD
Favorably willing of OARs usage in Academic Libraries	1.67	0.70
OARs are effective for Academic Libraries	1.70	0.73
OARs are alternatives to subscription resources	2.14	0.97
OARs are not peer-reviewed	2.91	1.11
OARs have a lower impact factor	2.81	1.10
Citations of OARs are not widely accepted	2.69	1.11
Open Access promotes wider accessibility of e-information	1.96	0.88
OARs are free of copyright and licensing restrictions	2.34	1.02
Anybody from anywhere can access OARs without any discrimination	1.95	0.79
OARs are efficiently archived	2.02	0.81

Adoption of OSS and OARs in University Library

The descriptive statistics of the adoption of OSS in university libraries depicts a moderate level of implementation. The respondents stated that their libraries have implemented OSS products (mean = 2.10) and have developed programs to be used regularly in future (mean = 2.23), which is a positive tendency of using OSS. Critical systems (mean = 2.56) and use in Institutional Research Repository (mean = 2.54) are slightly less adopted, suggesting that OSS has not penetrated any fundamental library operation yet. The libraries also reported moderate usage of OSS in the form of creating library guides (mean = 2.40) and as a tool of discovery (mean = 2.37) and involvement in the community of OSS (mean = 2.24) and staff training (mean = 2.33) are similar moderate. In totality, the research is an indication that although the usage of OSS can be



found in the libraries of Pakistani universities, the OSS is at an early or middle phase and can be expanded to include critical systems integration as well as staff training.

Descriptive statistics of the adoption of OARs in university libraries show that it has a moderate to high rate of access and use. Strong support of the popular resources is exhibited by the respondents stating that their libraries offer access to the HEC Digital Library (mean = 1.73) and Open Access Journals (mean = 1.95). Access and retrieval to other repositories, including Registry of Open Access Repositories (mean = 2.06), Black Open Access platforms (Sci-Hub, LibGen, mean = 2.14), DOAJ (mean = 1.97), and theses, dissertation and book directories (means of 2.04 to 2.13) were moderately reported. On the whole, the results indicate that Pakistani university libraries are already eager to implement OARs, in particular, highly recognized ones, but more specialized or off-central materials are slightly less available, which means that they can be more extensively incorporated and used.

Table 3: Descriptive Statistics of Adoption of OSS and OARs (N=221)

Statement	M	SD
Our library has adopted an OSS product.	2.10	1.07
Our library has established a program to regularly use OSS products in the future.	2.23	1.02
Our library uses OSS products in at least one critical system.	2.56	1.05
Our library is using OSS for Institutional Research Repository (IRR).	2.54	1.09
Our library is using OSS to develop library guides.	2.40	1.09
Our library uses an open-source interface as a discovery tool.	2.37	1.12
Our library actively participates in the open-source community.	2.24	10.02
Our library is training the staff to use OSS.	2.33	1.10
Statement	Mean	SD
Our Library provides access to the HEC Digital Library.	1.7285	0.79117
Our Library provides access to OA Journals.	1.9548	0.82448
Our Library retrieves material from the ROAR.	20.0188	0.90009
Our Library retrieves information from Black Open Access (Sci-Hub, LibGen).	2.1403	1.04153
Our Library retrieves information from DOAJ.	1.9729	0.88379
Our Library retrieves information from the Directory of OA Theses and Dissertations.	2.0633	0.97494
Our Library retrieves information from the Directory of OA Books.	2.0407	0.85449
Our Library provides access to ETD.	2.1312	0.97513



Inferential Statistics

Relationship between OSS Awareness and Perception

To investigate the correlation that exists between OSS Awareness and OSS Perception among the respondents, the Pearson correlation analysis was used to study the correlation between these two variables. The findings show that OSS Awareness total and OSS Perception total have a positive correlation ($r = 0.260$). This implies that the more awareness on OSS is created the better the perception of OSS amongst the respondents. The relationship between the two is weak to moderate but it is statistically significant due to the fact that the value of significance is $p = 0.001$ which is lower than 0.01. Hence, the correlation is significant at 0.01 level (2-tailed). The analysis has been conducted on a sample size of 221 respondents and this implies that the sample size is sufficient to the study. On the whole, the results indicate that the raising of awareness about OSS can contribute to the establishment of the more positive perceptions about OSS in individuals.

Table 4: *Correlation Between OSS Awareness and OSS Perception (N=221)*

		OSS Awareness total	OSS Perception total
OSS Awareness total	Pearson Correlation	1	.260
	Sig. (2-tailed)		0.001
OSS Perception total	Pearson Correlation	.260**	1
	Sig. (2-tailed)	0.001	

Relationship between OARs Awareness and Perception

Correlation analysis shows that there is a positive correlation between OAR awareness and OAR perception. The Pearson correlation coefficient ($r = 0.272$) reveals the weak to moderate positive correlation, which implies that the higher is the level of awareness of OAR, the higher will be the tendency of the perception of OAR among the respondents. The p-value of (Sig. =0.001) is lower than 0.01 meaning that the relationship is statistically significant at the level of 0.01 (2-tailed). This implies that this correlation cannot have been due to chance. A sample of 221 (N = 221) respondents is used to analyze the data. On the whole, the findings reveal that increased OAR awareness is linked with more positive views about OAR by the respondents.



Table 5: *Correlation Between OAR Awareness and OAR Perception (N=221)*

		OARs Awareness total	OARs Perception total
OARs Awareness total	Pearson Correlation Sig. (2-tailed)	1	.272 0.001
OARs Perception total	Pearson Correlation Sig. (2-tailed)	.272** 0.001	1

OSS Adoption’s Effect on Awareness and Perception Relationship

The model summary shows that there is an intermediate relationship between the independent and the dependent variable. The R = 0.520 value indicates that there is a moderate positive relationship between OSS awareness, OSS adoption and perception among professionals working in university libraries. The R² of 0.270 indicates that the independent variables (OSS awareness and OSS adoption) explain the variation in perception to the degree of about 27 percent. Adjusted R² (0.264) proves that even when the number of predictors is adjusted the model is still valid. Also, the F-change = 40.358 and a level of significance = 0.001 (less than 0.01) show that the model is significant. This implies that OSS awareness and adoption have a significant perception effect as a group. On the whole, the findings confirm the hypothesis that OSS awareness and adoption have a significant impact on the perception of university library professionals.

Table 6 : *Multiple Regression Predicting OSS Perception*

Model	R	R ²	Adjusted R ²	SE of Estimate	ΔR ²	F Change	df1	df2	P
1	.520	.270	.264	.46095	.270	40.358	2	218	0.001



ANOVA of Open-Source Software Adoption’s Effect on Awareness and Perception Relationship

Results of ANOVA show that the regression model in general is significant. The regression sum of squares in the model is 17.150 and the residual sum of squares are 46.319 with a total variance of 63.468. The F-value of 40.358 with degrees of freedom (df = 2, 218) is highly significant at p = 0.001 (< 0.01). This indicates that the independent variables, i.e. OSS awareness and OSS adoption, together exert a considerable influence on the dependent variable, OSS perception. The model is a good fit to the data and the predictors play an important role in explaining differences in the perception of the university library professionals. Thus, the findings confirm the hypothesis that OSS perception is significantly influenced by awareness and adoption.

Table 7: ANOVA^a for Multiple Regression Predicting OSS Perception

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	17.150	2	8.575	0.358	0.001 ^b
Residual	46.319	218	.212		
Total	63.468	220			

- a. OSS perception (dependent variable) total
- b. Predictors: OSS Adoption total, OSS Awareness total

Coefficient of Open-Source Software Adoption’s Effect on Awareness and Perception Relationship

The coefficients table presents the individual contribution of each predictor to OSS perception. The constant value (B = 1.133, p = 00.001) indicates the baseline level of perception when all predictors are zero. OSS awareness shows a positive but marginally significant effect on perception (B = 0.063, β = 0.119, p = 0.010), suggesting that an increase in awareness slightly improves perception among university library professionals. In contrast, OSS adoption has a strong and highly significant positive effect on perception (B = 0.296, β = 0.472, p = 0.001), indicating that greater use of OSS substantially enhances perception. The standardized beta values further confirm that adoption is the most influential predictor in the model compared to awareness.

Table 8: Coefficients Predicting OSS Perception

Predictor	B	SE B	B	t	p
Constant	1.133	.109	—	10.378	.001
OSS Awareness	0.063	.032	.119	1.967	.010
OSS Adoption	0.296	.038	.472	7.777	.001



OARs Adoption’s Effect on Awareness and Perception Relationship

The summary of the model suggests that there is an average correlation between the variable (independent) and the variable(dependent). $R = 0.398$ indicates a moderate positive relationship between OAR awareness, OAR adoption and perception by university library professionals. $R^2 = 0.158$ indicates that OAR awareness and adoption explain the perception variance at a rate of about 15.8%. The adjusted R^2 (0.150) also supports the reliability of the model that has taken into consideration the number of predictors. Also, the F-change of 20.456 with a level of significance of $p = 0.001$ (less than 0.01) also shows that the model is significant. This implies that perception is significantly influenced by OAR awareness and adoption. In general, the findings indicate the hypothesis that Open Access Resources awareness and adoption can have a strong effect on university library professional perception, but the model does not explain the data as well.

Table 9: *Multiple Regression Predicting OARs Perception*

Model	R	R ²	Adjusted R ²	SE of Estimate	ΔR ²	F Change	df1	df2	p
1	.398	.158	.150	.54768	.158	20.456	2	218	0.001

ANOVA of Open Access Resources Adoption’s Effect on Awareness and Perception Relationship.

The results of ANOVA indicate that the overall regression model is significant. The regression sum of squares is 12.271 and the residual sum of squares is 65.389 and the total variance is 77.660. The model produces an F-value of 20.456 with degrees of freedom (df = 2, 218), which is significant at $p = 0.001$ (< 0.01). This shows that the independent variables, OAR awareness and OAR adoption, have a strong impact on the dependent variable, OAR perception, in combination. In other words, the model is a good fit, and the predictors significantly explain variations in perception among university library professionals. Thus, the results confirm the hypothesis that the awareness and adoption of OARs is significant in influencing the perception, which is explained with moderate values.

Table 10: *ANOVA for OARs Perception*

Source	SS	df	MS	F	p
Regression	12.271	2	6.136	20.456	.001



Residual	65.389	218	.300
Total	77.660	220	

Coefficient of Open Access Resources Adoption’s Effect on Awareness and Perception Relationship.

The table of coefficients reveals the respective changes caused by the OAR awareness and adoption on perception. The constant ($B = 1.523, p = 00.001$) is the level of perception at which all the predictors remain at the same level. OAR awareness positively but statistically non-significant impacts perception ($B = 0.048, = 0.080, p = 0.283 > 0.01$) showing that awareness in itself has no significant effect on the perception of university library professionals. Conversely, adoption of OAR indicates that there is a positive and significant impact on perception ($B = 0.296, 5 = 0.348, p = 00.001$), meaning that more frequent usage of OARs has a significant and positive impact on perception. The standardized beta values also indicate that the adoption is the more effective predictor than the awareness.

Table 11: *Regression Coefficients Predicting OAR Perception*

Predictor	B	SE B	B	t	p
Constant	1.523	.115	—	13.246	.001
OAR Awareness	.048	.045	.080	1.077	.283
OAR Adoption	.296	.063	.348	4.669	.001

Discussion

The current study attempted to explore the status of OSS and OARs in University Libraries of Pakistan as per data collected from library professionals’ providing services there. The outcome of the study is discussed below as:

Awareness of OSS in university libraries

The study revealed that both library OSS, Koha and DSpace, were recognized by all Library Professionals of University in Pakistan. Similarly, Populational of the study were also aware of Calibre and Greenstone library OSS. Similarly, the findings of this study are in line with the study of Ahmad, Ibrahim, Ahmad and Hussain (2024) as they noted that Koha, Greenstone, DSpace and Slims were most recognized Open Source Software among Library Professionals. Another study revealed that the professionals of academic libraries are well with Koha, DSpace



and Greenstone OSS and intended to adopt these OSS for automate and digitize their libraries (Mohideen, 2017).

Perception about OSS in University Libraries

This study also discovered that population of this study was in favor of using library OSS in DAIs Libraries, although, most of the respondents perceived library OSS lesser user-friendly than proprietary software for libraries. Similarly, the comparative study between OSS and Proprietary Software conducted by Imoro (2022) revealed the same results as deduced by the current study and interpreted that OSS of libraries contained many modules, therefore, expertise of library staff is also required accordingly. Whereas, personnel and employees with not much expertise can use operate proprietary software. Moreover, another study conducted in Pakistan regarding the perception of OSS in University libraries found these OSS very beneficial and effective for library functions and services (Hassan, Hamid, Information, & 2022, 2022). The study conducted in Bangladesh by Ahammad, Saiful Bahri and Husaini (2024) produced the same results and finding of their study was also expressed that professional librarians in academic libraries perceived OSS very effective and practical for their libraries. Their study also concluded that in terms of finance the OSS are less expensive and better option for developing countries.

Adoption of OSS in University Libraries

The current study also explored that DAIs libraries were using and implementing OSS either as Integrated Library Software, for Repository development, for federated search (discovery tool) or as library guides. The recently conducted study by Kumar Mishra Mishra and Agarwal (2026) in India also explored that academic libraries were using OSS for their functions and serves as integrated library software, for development institutional repository, library guides and as discovery tool for federated search. Similarly, another study conducted in African Country, Angola, reported that free and OSS were the first priority of the libraries and the most of the academic libraries were relying on OSS. The day to day functions and routine tasks were being performed by library professionals with the help of OSS (Silva, 2024)

Awareness of OARs in University Libraries.

The study reflected that the PRR and DOAJ had the highest awareness and more respondents were quite aware with the two resources. The study further indicated that respondents were also familiar of Black Open Access platforms (Sci-Hub, LibGen). The findings of the study



were aligned with the previous studies conducted in Pakistan by Sultan and Rafiq (2021) and Sheikh and Richardson (2023) who also found in their studies that PRR resource is widely recognized and known in academic libraries by the professionals, besides, their studies also concluded that library professionals were aware with Directory of Open Access Journal (DOAJ). The relevant study conducted in Iran also explored the similar findings and described that library professionals were using the Open Access resources in their libraries to retrieve the desired information of the library patrons. The study further expressed that library professionals were familiar with Open Access tools and databases in academic libraries of Iran (Subaveerapandiyani, Seifi, Shimray, & Ahmad, 2025)

Perception about OARs in University Libraries

The study indicated that respondents were very willing to use OARs and Considered OARs were effective and facilitate greater accessibility of e-information. They also noted that OARs offer unrestricted access to the users and these resources were good to be archived. Moreover, the respondents were also not agreed with the myth that OARs were poorly reviewed and had a lesser impact factor and limited citation acceptance. The relevant previous study recently conducted in the KPK Province of Pakistan by Ullah Khan (2025) produced the similar results and revealed that e-resources were widely utilized for academic purposes, including literature reviews, thesis writing, and research publication development. Another previous study conducted in academic libraries of Pakistan by Sultan and Rafiq (2021) validated that OARs were perceived by the professionals as game changer and widely accepted alternative of print resources in libraries. The finding of similar study conducted in India also indicated that professionals working in academic libraries widely accepting the role of digital resources (Vijayalatha, 2023).

Adoption of OARs in University Libraries

The study explored that all respondents were offering access to the Digital Library of HEC, DOAJ and relevant other resources to their patrons. One previous study relevant with the current study conducted in academic institutes of Nigeria by Bello, Nsofor and Falode (2021) indicated that DOAJ were used by the professional librarians to fulfill the queries of library patrons. Another research conducted in South East Nigerian Universities also explored that university libraries were using and providing access to the IRR other than certain subject repositories, journals available as



open accessed, personal websites through the internet, e-books many other similar services (Sambe & Raphael, 2015).

Recommendations

Enhancing Awareness

- Train and make more people aware of unknown OSS platforms and specialized OARs through training sessions, workshops, and seminars.
- Create informational resources and guidelines of library employees concerning OSS and OAR advantages, use, and incorporation.

Improving Adoption

- Incentive Use libraries to start embedding OSS in important systems and institutional repositories progressively.
- Increase the utilization of OARs to other library services and provide smooth access to the end-user.

Capacity Building

- Offer technical training to library employees to eliminate difficulties of implementing and customizing OSS.
- Infrastructure and Resource Barriers Infrastructure and Resource Barriers
- Budget more on OSS implementation and infrastructure development.
- Increase the internet access and IT assistance within the library of the university to access the OARs.

Promotion through Community Engagements

- The promotion aims to foster appreciation and widespread participation of students, teachers, parents, and the community in the joint ownership of the program.
- The objective of promotion would be to bring appreciation and the general involvement of students, teachers, parents, and the community in the collective ownership of the program.
- Promote the involvement in OSS communities of developers in order to share more support and resources.
- Continuously collect user feedback in order to enhance satisfaction with OSS and OARs systems.

Policies and Strategic Support



- The policy and strategic support functions concentrate on the formulation of company policies and strategic plans aimed at maintaining the company's competitiveness and sustainability in the dynamic business environment.
- The functions of policy and strategic support focus on the development of company policies and strategic plans to ensure that the company remains competitive and sustainable in the dynamic business environment.
- Formulate institutional policies that encourage the use of OSS and OARs in all libraries of universities.

Ensure continuous monitoring

- Review of integration of OSS and OARs is permanently required to ensure maximization of the effectiveness.

Future Research Directions

- Longitudinal studies should be carried out to determine how OSS and OAR perceptions change with time.
- Introduction of new open-source technologies and digital repositories and their effects on library services.

Conclusions

It is concluded that the awareness level of professionals in the university libraries towards OSS and OARs is different. Some of the software like KOHA, DSpace, Calibre and Grenstone are amongst leading OSS which are better known by the library professionals. Similarly, some of the resources like Pakistan Research Repository (PRR) and DOAJ are amongst the most known resources whereas the other sites and resources are not so well-known. Moreover, in Black Open Access 'Sci-Hub' is also a well-known OAR. The overall perceptions are positive, and the respondents admit that OSS is useful, flexible, and cost-effective, similarly, OARs are readily available and inclusive. The relationship between awareness and perception of the library heads of Universities / DAIs was also significant.

There is moderate adoption of OSS in libraries and most of the libraries are adopting it to perform general operations but not for critical systems or institutional repositories. Moreover, mostly Koha is adopted by libraries in universities and little is known and used by libraries for library operations other than Koha. The adoption of OARs is greater with the major resources



being implemented broadly especially in accessing journals and digital libraries. Moreover, the OARs are more effectively being used by those library professionals in universities whose awareness and perception about these resources were better.

Limitations of the Study

There may be a possibility of limitations in almost every research investigation on account of research methodology, sampling, sample size, data collection and analysis, response rate and so forth. The present study also has a few limitations that might be kept in view while reading its findings:

1. This study was designed using quantitative approach and survey method only.
2. This study collected research data from the one Head or representative of DAIs Libraries only.
3. The findings of this research might be different while investigating the same phenomenon through employing multi-methods of research.
4. Due to time constraints the responses of all respondents could not be recorded, although, followed up by the researcher time and again.
5. The research could be studied on a larger scale by adding the library patrons' views about the usage of OSS and OARs.
6. This study explored the use of OSS and OARs in libraries of DAIs in Pakistan. Future research might be carried out on a large scale including all academic as well as public, special and National libraries of Pakistan.

Note: This paper has been abstracted from the PhD thesis.

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