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Librarians Perceptions about Adoption of Cloud Computing in University Libraries of Pakistan

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ABSTRACT

This study explores the perceptions of university librarians in Punjab, Pakistan, regarding the adoption and use of cloud computing in their libraries. Utilizing a quantitative research approach, data were collected from 212 university librarians through a structured questionnaire. The findings reveal that a majority of librarians recognize the significant benefits of cloud computing, including enhanced data security, improved accessibility to library resources, and efficient collaboration among staff and users. Popular cloud-based services in use include web-OPAC, cloud backup, email services, and library websites. Despite these advantages, the study identifies several challenges: high implementation and maintenance costs, concerns over data security and privacy, complex initial setup and migration processes, and the reliability of internet connectivity. The study concludes that while cloud computing holds transformative potential for university libraries, addressing the associated challenges through strategic planning and user engagement is crucial. These insights can guide the successful implementation and optimization of cloud computing in university libraries, enhancing service delivery and resource management in the digital age.

| **Keywords:** | Challenges, Cloud Computing, Cloud-Based Library Services |

Introduction

Cloud computing is an innovative technology that has arisen over the past few years and has been embraced by numerous organizations. Cloud computing is one of the most significant technological advances. Cloud computing enables individuals to share applications, therefore it may ease the exchange of data, information, expertise, and services (Han, 2015). As a result, there is no need for organizations to become familiar with all sorts of novel technology and software, investing a significant portion of their monetary assets on employing new personnel and maintaining databases. Hence, they must cover the expenses of computations, activities, and resources (Wang, Zhong & Li, 2022). The advantages of cloud computing include cost savings, collaborative services and tools, expedited services, decreased demand for assistance, and so on, which has prompted organizations to examine this technology as an alternate (Gohil, Alapati & Joglekar, 2011).

Cloud computing pertains to the delivery of computational amenities via the web, covering software, storage, and computational capability. In lieu of housing data and executing applications on nearby servers or individual computers, cloud computing allows individuals to retrieve and employ these assets through a network of distant servers (Thanuskodi, 2012). The "National Institute of Standards and Technology" (NIST) defined it as "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal

management effort or service provider interaction." Cloud computing offers many benefits to users, including lower costs, greater scalability, increased efficiency, and improved reliability (Ali et al., 2024; Kang et al., 2024). There are three main types of cloud computing services: "Infrastructure as a Service (IaaS)", "Platform as a Service (PaaS)", and "Software as a Service (SaaS)". Some popular examples of cloud computing services and platforms include "Amazon Web Services (AWS)", "Microsoft Azure", "Google Cloud Platform (GCP)", and "Dropbox" (Jahangiri, Saberi & Vakilimofrad, 2021).

Cloud computing is widely used in libraries as a versatile means of delivering and maintaining digital services and resources. Further, Sarah T. Jewell in his article in the Journal of Library Administration says, Cloud computing enable libraries to access resources on demand rather than having to invest in physical hardware and software (Jewell, 2016). One advantage of cloud computing for libraries is a possibility of data and applications storage and access on distant servers, not on the local hardware. This can help in cutting costs and improve efficiency since libraries can lease the necessary computing power as and when they need it, instead of having to buy their own equipment and licenses. According to a report by K. J. Malhan of the Indian Institute of Technology (IIT), cloud computing brings in dynamic, scalable and flexibility in the hosting of data, applications and services in the libraries (Makori, 2016). Nevertheless, there are also some issues and concerns with regard to cloud computing for libraries. Some of these may be as follows; Issues of security of data, and privacy of information that may be stored on the cloud, lock in, and the need to exercise caution when choosing cloud services and/or service providers (Aslam et al., 2022; Shabbir & Ali, 2021). According to Jewell, libraries should carry out research on the cloud computing provider of their choice concerning security, privacy, and data transferability (Mavodza, 2013).

Cloud computing in university libraries is a complex issue that requires the analysis of the various aspects such as technical, financial and organizational issues. Despite the fact that cloud computing seems to have benefits for university libraries including scalability, flexibility and cost, it also poses risks and challenges. Some of the issues that affect adoption of cloud computing by university libraries are; concerns on security and privacy, risk of being locked to the vendor, and the need to be very keen while selecting the service and vendor to offer the services. Moreover, there can be cultural and organizational factors that would hinder the implementation of such solutions, for example, the resistance to change or absence of technical skills. Thus, there is an urgent call for the investigation of the prospects and issues regarding the implementation of cloud computing in Pakistani university libraries and how these issues can be overcome to enhance the prospects of effective adoption of cloud technologies in university libraries.

Literature Review

Cloud computing involves the provision of computer resources, including hardware, software, storage, and networking, through the internet. Rather than possessing and managing physical equipment and software locally, individuals and organizations can remotely access and utilize these resources via cloud service providers (Yao & Azma, 2021). Cloud computing has a long history that has evolved via many technology developments, philosophies, and paradigms. The notion of remotely sharing computing resources dates back to the 1960s. Cloud computing offers a range of services and deployment strategies tailored to diverse demands and use cases (Shoaib et al., 2020; Ali & Naveed, 2020). Users can provision and manage resources such as processing power and storage as required, without the need for direct human intervention from the service provider (Tashkandi & Al-Jabri, 2015). Cloud services are accessible over the internet through various devices, including personal computers, smartphones, and tablets. Cloud providers consolidate and distribute computer resources to serve numerous clients. These resources are dynamically allocated based on demand, ensuring effective utilization (Bhatti et al., 2023; Naveed et al.,

2021). Cloud resources can be rapidly adjusted to accommodate fluctuating workloads. This scalability offers flexibility and cost efficiency (Cao, Liang & Li, 2018).

Cloud computing is typically categorized into three main service models including "IaaS", "PaaS", and "SaaS" (Islam et al., 2022). IaaS) is a service that provides virtualized computing resources over the Internet. Users can choose to rent virtual machines, storage, and networking components. They have enhanced control over infrastructure and can install and manage their own software and applications. PaaS offers infrastructure, runtime environments, and development tools on a unified platform (Kumar, 2021). Developers can create, deploy, and manage applications without needing to concern themselves with the underlying infrastructure. SaaS provides complete software applications over the internet through a subscription model. Users can access these applications without requiring local installation or maintenance. Examples include email services, office productivity suites, and customer relationship management systems (Akporhonor & Ekhaguosa, 2021).

Cloud-based Library Services

The utility of cloud computing in the management of university library services is also immense in the following ways: Some of the areas benefiting from cloud-based services are cataloguing and classification, circulation, acquisition and digital repositories that facilitate management and availability of academic resources (Yuvaraj, 2015; Yuvaraj, 2016). These platforms offer the capability of remote access, the possibility of automatic updates, and scalability, which is useful when it comes to improving the management of collections and the performance of various administrative functions (Ali et al., 2023; Naveed et al., 2023). Libraries can also manage digital resources like e-books, journals, and databases more efficiently, the tools for usage statistics, subscriptions, and licensing (Rodrigues & Godoy, 2018).

Cloud solutions allow library resources to be accessed remotely thereby allowing students and staff to access materials irrespective of their location. Another area of improvement is the collaboration that is made possible by the use of cloud-based applications where library staff, instructors, and students can work together on projects and share documents (Islam et al., 2022). Usage data is analyzed on the cloud and informs collection development and service optimization. Furthermore, cloud-based communication mediums such as chatbots provide instant support, and the interlibrary loan system supports the sharing of resources (Sarkar & Shaw, 2021). Cloud technologies also help in the conservation of special materials and compatibility with university Learning Management System (LMS) for better resource availability and convenience to the users (Akporhonor & Ekhaguosa, 2021). Other advantages include hosting virtual events and backing up data securely through cloud solutions. Altogether, these services contribute positively to the optimization of operation and resource delivery in university libraries (Tella, Ukwoma & Adeniyi, 2020).

Challenges Associated with Cloud Computing

There are various challenges associated with cloud computing in libraries, majorly in the area of security and privacy of data. Libraries hold sensitive information, and share this information with the cloud, which makes it susceptible to compromise through weaknesses or hacking (Liu & Cai, 2013; Wasike, 2015). Ownership and control of data and its usage by cloud providers is another issue, which requires proper legal frameworks where ownership and usage rights of the data are well spelt out in the contract between the cloud service provider and the cloud consumer (Makori, 2016; Yuvaraj, 2016). Availability and reliability are important concerns, as cloud services heavily rely on internet connection. Public library services in regions with low internet connection may be affected causing challenges to the running of the services and access by users (Adetoro & Ayeni, 2020). In

addition, high uptimes are attainable for cloud providers; however, outages may impact essential library operations (Shoaib et al., 2021; Ullah et al., 2022). Another key issue that can be mentioned is the costs' management. Libraries face many challenges in terms of cost, including confusing pricing models and hidden costs from overspending on resources that are not effectively managed (Kumar, 2021).

Scalability is crucial to minimize expenses, and transitioning between cloud services or on-premises platforms can be costly and complex. Cloud migration requires the movement of massive amounts of data and the linking of the existing on-premises systems with cloud services, which is time-consuming and challenging (Islam et al., 2022). There is also the fact that legacy software may require some adjustments to be made in order to work with cloud infrastructure, which makes the challenge even greater (Aslam et al., 2021; Zhao, 2023). Challenges relating to data ownership and governance emerge when libraries shift to the cloud. Some of the issues that libraries are facing include the reliance on cloud providers to safeguard their data and meet the legal requirements of privacy. The protection of data and the handling of information that is sensitive is another area that must be analyzed with the utmost rigor concerning the policies of cloud providers (Yakubu, Kassim & Husin, 2024).

The literature reviewed above indicates that studies have been undertaken to explore cloud computing in libraries worldwide. However, there is a notable absence of research investigating cloud computing applications in Pakistani university libraries. Consequently, this study aims to bridge this gap in the literature and provide a comprehensive understanding of the implementation of cloud computing applications in university libraries across Pakistan.

Material and Methods

When various dimensions of a phenomenon have been explored, a quantitative research approach is best suited to examine perceptions in a new setting. Therefore, a quantitative research approach was employed to capture the perceptions of university librarians regarding the adoption and use of cloud-based library services in Pakistan. University librarians from Punjab province were purposively selected for this study because they tend to be more technology-oriented compared to librarians working in other types of libraries.

To achieve the objectives of the study, a questionnaire was developed in the light of literature review. However, a pilot testing was conducting to enhance clarity and evaluate respondents' comprehension levels, as well as the time required to complete the questionnaire. The content validity of the questionnaire was ensured through expert opinions. Moreover, reliability of the questionnaire was ensured by employing Cronbach alpha reliability test in SPSS. According to this test, all three section got alpha reliability value above 0.80 which is the indicated that questionnaire has no reliability issues (Hair et al., 2006). The data was collected through Goggle Doc from the 212 university librarians. Finally, the collected data was analyzed through SPSS.

Results and Discussion

The collected data analyzed in following various headings.

Demographic Information

The findings revealed that the majority of respondents were librarians 155 (73.1%), with 26 (12.3%) as senior librarians and 17 (8.0%) as chief librarians. Most respondents worked in public university libraries 119 (43.9%) compared to private ones. The majority were male 163 (76.9%), while 49 (23.1%) were female. Regarding age, 59 (27.8%) were

aged 26-30 years, 58 (27.4%) were 31-35 years, and 42 (19.8%) were above 40 years old. Most respondents 117 (55.2%) held an M.Phil in Library and Information Sciences/Information Management, while a significant number had a Master's degree 87 (41.0%) in the same field. In terms of work experience, 81 (38.2%) had 11-15 years of experience, and 45 (21.2%) had 6-10 years of experience.

Table 1
Demographic Information

Variable	Level	Frequency	Percentage
Designation	Chief librarian	17	8.0
	Deputy Librarian	14	6.6
	Senior Librarian	26	12.3
	Librarian	155	73.1
Type of university	Public	119	56.1
	Private	93	43.9
Gender	Male	163	76.9
	Female	49	23.1
Age	21-25	16	7.5
	26-30	59	27.8
	31-35	58	27.4
	36-40	37	17.5
	Above 40	42	19.8
Qualification	MLIS/BS	87	41.0
	M.Phil	117	55.2
	PhD	8	3.8
Work experience	1-5	29	13.7
	6-10	45	21.2
	11-15	81	38.2
	16-20	37	17.5
	Above 20	20	9.4

Reasons Behind the Adoption of Cloud Computing

The respondents were asked about the reasons behind the adoption of cloud computing. Table 4.2 presents the results regarding the reasons behind the adoption of cloud computing. The findings revealed that majority of the respondents were agreed that cloud computing enhances data security and backup capabilities in university libraries (Mean=4.24, SD=0.60), the adoption of cloud computing allows for better accessibility of library resources for users (Mean=4.21, SD=0.55), cloud computing enables efficient collaboration among library staff and users (Mean=4.21, SD=0.62), and cloud computing enables better remote access to library resources and services (Mean=4.19, SD=0.59).

Table 2
Reasons behind the Adoption of Cloud Computing (N=212)

Sr. #	Statements	Mean	SD
i)	Cloud computing enhances data security and backup capabilities in university libraries	4.24	0.60
ii)	The adoption of cloud computing allows for better accessibility of library resources for users	4.21	0.55
iii)	Cloud computing enables efficient collaboration among library staff and users.	4.21	0.62
iv)	Cloud computing enables better remote access to library resources and services.	4.19	0.59

v)	The use of cloud computing reduces the need for physical infrastructure and maintenance costs in university libraries.	4.13	0.64
vi)	The adoption of cloud computing improves the sustainability and environmental impact of university libraries.	4.13	0.62
vii)	Cloud computing improves the scalability and flexibility of library services.	4.09	0.64
viii)	Cloud computing allows for cost-effective storage and management of large volumes of data in university libraries.	4.09	0.65
ix)	Cloud computing facilitates seamless integration with other library systems and technologies.	4.05	0.62
x)	Cloud computers is user friendly	4.05	0.65

Cloud-based Library Services

The respondents were queried regarding the utilization of cloud-based services in their libraries. The results (Table 4.3) indicated that respondents reported using a variety of cloud-based services, including web-OPAC (Mean=4.00, SD=0.88), cloud backup and disaster recovery (Mean=3.96, SD=0.96), email-based services (Mean=3.95, SD=0.85), and library website (Mean=3.89, SD=0.90).

Table 3
Cloud-based library services (N=212)

Sr. #	Statements	Mean	SD
i)	Web-OPAC	4.00	0.88
ii)	Cloud Backup and Disaster Recovery	3.96	0.96
iii)	Email-based services	3.95	0.85
iv)	Library website	3.89	0.90
v)	Remote Access to Databases	3.76	0.93
vi)	Cloud-based Integrated Library Systems	3.64	1.01
vii)	Cloud-based Analytics and Reporting	3.62	1.06
viii)	Cloud-based Discovery Services	3.59	0.99
ix)	Cloud-based Virtual Learning Environments	3.57	0.98
x)	Cloud-based Institutional Repositories	3.56	1.03
xi)	Cloud-based Mobile Applications	3.56	1.05
xii)	Cloud-based Interlibrary Loan Services	3.44	1.09

Challenges Associated with Cloud Computing Adoption and Usage

The respondents were asked about the challenged associated with cloud computing adoption and usage. The findings related to challenges are listed in Table 4.4. The results showed that majority of the respondents were agreed that the cost of implementing and maintaining cloud computing services (Mean=4.06, SD=0.64), Concerns about data security and privacy (Mean=4.06, SD=0.64), the initial setup and migration process to cloud-based systems is complex and time-consuming (Mean=4.04, SD=0.62), and availability and reliability of internet connectivity (Mean=4.04, SD=0.65) were the major challenges of cloud computing adoption and use in their university libraries.

Table 4
Challenges Associated with Cloud Computing Adoption and Usage (N=212)

Sr. #	Statements	Mean	SD
i)	The cost of implementing and maintaining cloud computing services.	4.06	0.64
ii)	Concerns about data security and privacy	4.06	0.64

iii)	The initial setup and migration process to cloud-based systems is complex and time-consuming	4.04	0.62
iv)	Availability and reliability of internet connectivity	4.04	0.65
v)	Concerns about vendor lock-in and dependency on third-party cloud service.	4.03	0.60
vi)	Limited staff expertise and training in cloud computing technologies.	4.00	0.67
vii)	Resistance to change and cultural barriers within the university library.	4.00	0.67
viii)	Integration and interoperability issues	3.98	0.61
ix)	Limited IT infrastructure and resources	3.95	0.69

Gender influences on adoption of cloud computing

An independent t-test was conducted on each construct of cloud computing adoption and usage to assess the disparity between the opinions of male and female respondents. The results (Table 4.5) indicated that none of the constructs exhibited a significant difference between the opinions of male and female respondents. For instance, both male and female participants exhibit similar views regarding the reasons behind the adoption of cloud computing, with mean scores of 4.15 and 4.10, respectively, yielding a non-significant t-value of 0.67 and a p-value of 0.50. Similarly, perceptions about cloud-based library services and challenges associated with cloud computing adoption do not exhibit significant gender-based discrepancies. These findings suggest that gender does not appear to play a significant role in shaping attitudes and perceptions regarding cloud computing adoption in the context of library services. Thus, when considering strategies for implementing cloud technologies in libraries, gender-specific approaches may not be necessary, as both male and female perspectives align closely on these matters.

Table 5
Gender influences on adoption of cloud computing

Sr #	Statements	Mean		t-value	Sig.
		Male	**Female**		
i)	Reasons behind the Adoption of Cloud Computing	4.15	4.10	0.67	0.50
ii)	Cloud-based Library Services	3.68	3.72	-0.33	0.74
iii)	Challenges Associated with Cloud Computing Adoption and usage	4.03	3.99	0.48	0.62

Differences in adoption of cloud computing w.r.t types of university

Independent t-test was applied on each construct of the cloud computing adoption and usage to examine the difference between the opinions of respondents from public and private university libraries. However, across the statements, the data indicates nuanced differences in perceptions between the two types of institutions. Notably, in terms of reasons behind cloud computing adoption, both public and private universities exhibit nearly identical mean scores, with a negligible difference reflected in the t-value, suggesting no significant disparity in their motivations for embracing cloud technology. However, when considering cloud-based library services, the analysis reveals a slightly higher mean score among private universities compared to public ones, although the difference falls just shy of statistical significance (p = 0.06). Similarly, challenges associated with cloud computing adoption demonstrate no significant divergence between public and private universities, as indicated by the respective mean scores and t-values. Overall, while there may be subtle variations in perceptions of specific aspects of cloud computing, the analysis suggests a generally consistent outlook on cloud adoption between public and private universities, highlighting a shared understanding of the benefits and challenges associated with integrating cloud technologies in library services across both types of institutions

Table 6
Differences in adoption of cloud computing w.r.t types of University

Sr. #	Statements	Mean		t-value	Sig.
		Public	Private		
i)	Reasons behind the Adoption of Cloud Computing	4.14	4.14	0.03	0.97
ii)	Cloud-based Library Services	3.60	3.80	-1.86	0.06
iv)	Challenges Associated with Cloud Computing Adoption and usage	4.04	3.99	0.76	0.44

Discussion

The study aimed to investigate university librarians' perceptions regarding the adoption of cloud computing applications in their libraries, with specific objectives focused on understanding reasons behind adoption, the range of cloud computing-based services, importance, challenges, suggestions for improvement, and variations based on certain demographics. Through a quantitative research approach targeting 212 university librarians from Punjab, key insights were gleaned regarding the adoption and utilization of cloud computing in university library settings.

A very significant observation to emerge from study and which was backed by most of the respondents was that cloud computing helped in the improvement of data security and data backup in university libraries. Most of the respondents had a positive perception regarding the accessibility of resources for users, efficiency of the worker and user collaboration as well as the availability of remote services from a library. Such results make envision cloud technology as a valuable solution for changing the view of library functioning as well as improving the clients' experiences. In addition, web-OPAC, cloud backup and disaster recovery, e-mail based services, and library websites were named by many of the respondents as cloud services that they employ (Esmaeili, Isfandyari-Moghaddam, & Hafezi, 2022). This infers that university libraries are incorporating the use of cloud solution in their technological advancement and provision of services, (Han, 2015).

Nevertheless, the study revealed the following difficulties arising from the adoption and use of cloud computing by university libraries. Some of the concerns raised by the respondents included the cost implication of the solution and the recurring costs involved in maintaining the solution, issues to do with data security and privacy, and the fact that the implementation process and migration from traditional methods to cloud-based solutions are time-consuming and complex. Besides, the accessibility and dependability of internet connection was another factor that came out clearly as a factor that hampers the effective use of cloud computing services. In turn, the received information contained useful recommendations for the enhancement of cloud-based library services. Some of the recommendations that were made were on data protection where it was recommended that the application should adhere to the set data protection laws, use of cloud collaboration tools for real time communication, use of big data analytics to determine the users' behavior and preferences, and soliciting for user's feedback so as to know the areas that require improvement. In sum, the study reveals the dynamic applicational changes that cloud computing is bringing to the university library services and systems. Nevertheless, it is argued that library administrators and policymakers should consider the identified challenges and apply the suggested strategies to enhance the use of cloud computing in university libraries (Makori. 2016). Thus, libraries become more capable of addressing the current needs and demands of users and addressing new technologies.

The research used various tests to analyze the differences and trends of cloud computing adoption and usage perceptions across the different categories of the university libraries. The findings of these tests reveal the different consciousness and concerns that

people have concerning the adoption of cloud technology in learning institutions. Firstly, independent t-tests were used to compare the results of male and female respondents, and no significant differences were observed in the perception of the subjects in relation to any of the constructs concerning cloud computing adoption and use. This means that university librarians have a sex-blind attitude towards cloud technology, which means both the male and female participants had similar perceptions of why, why it is important, why it is challenging, and what needs to be done to enhance its use. The same case applies to the comparison of the respondents originating from the public and private university libraries where there were no significant differences in all the constructs. This shows there is a similar understanding of cloud computing adoption and usage between the two types of libraries, meaning that both organizations can appreciate the advantages, risks and opportunities that come with the implementation of cloud technology

Conclusion

This research gives a valuable insight on the direction of using cloud computing in universities' libraries in Punjab; thus, a glimpse at a bright future of digital advancements. With university librarians being the knowledge managers, the majority express optimism in cloud computing's performance in increasing data security, improved accessibility, as well as promoting efficient collaboration. Cloud technology has opened up possibilities that were unimaginable in the past; there is unparalleled remote access and a string of strong cloud-based services like a web-OPAC, cloud, and dynamic email. Nevertheless, this digital leap is not without some sort of impediments. School Librarians expressed the financial factor, concern with data, the complexity of the systems in place, and the continuity of the internet connections. These challenges therefore call for very keen planning and management of the available resources. To navigate these waters, the study proposes a forward-thinking approach: comply with higher levels of data protection, incorporate the use of tools for synchronous communication, leverage on the use of data and analytics, and focus on the use of feedback to engage users. They prospect of these strategies extends to not only reducing the challenges mentioned above but also to even raising the library experience to an unknown level. Altogether, the research reveals the direction in which the synergy of cloud computing and library services can transform the academic environment. If managed and developed properly and with a foresight, the libraries of the universities can go beyond the limited bridges to transform into the shining examples of the contemporary society openness and forward-thinking approach to the future.

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