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The Influence of Emerging Technologies on Library Services: A Comparative Study of Public and Private University Libraries

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Abstract

Purpose-This study aims to investigate the perception of university librarians towards the use of emerging technologies (Augmented/virtual reality, cloud computing, semantic web/linked data, Bibliographic Framework, current awareness services, Really Simple Syndication feed,Big Data, Radio Frequency Identification, and WeChat)in performing library services(user, technical, instructional, and managementservices).
Design/methodology/approach- A survey research method was used to conduct the study. A quantitative research approach was applied with a structured questionnaire. The sample size of the study consisted of 218 library professionals (working in public and private sector universities)who were selected through convenient sampling. The data was analyzed by using SPSS.
Findings- Results show that most of the respondents aremoderately aware of emerging technologies that are being used in libraries. The private university librarians are marginally better than their counterparts. However, there is no significant differencebetween public and private university librarians in terms of awareness of emerging technologies in performing user services, technical services, and management services. Conversely, there is a significant difference between both types of librariansin providing instructional services.
Originality/value-This paper tries to highlight the awareness of university librarians about emerging technologies in libraries.
Keywords-AR, VR, cloud computing, BIBFRAME, CAS, RSS feed,big data, and RFID

Paper type:- Research paper

1 Introduction

Emerging technologies for libraries refer to any new technology that can help/support library services like user, instructional, management, and technical. Now user services are delivered through augmented/virtual reality and cloud computing. Instructional servicesexplain the idea of current awareness services (CAS) anda really simple syndication(RSS) feed. Technical services includeBibliographic Framework (BIBFRAME) and semantic web/linked data, and libraries provide management services through big data, Radio Frequency Identification(RFID), cloud computing, and mobile-based services(Yang and Li, 2016).

Dutt (2015)determined that cloud computing is the use of the internet for computer applications like OCLC Webscale, Ex-Libris cloud, dataspace,DuraCloud, etc. which enhances the services and provides services like email, word processing, image, and video sharing. These services are safe and accessible with any form of internet connection and contain backup in their settings.Sivankalai (2021)is one step ahead and illustrates that all library collections, systems, and services will be cloud-based in the next five years. Moreover, iCloud, Livedrive, IBackup, IDrive, Amazon Cloud Drive, Dropbox, Google Drive, One Drive, and Box are theapplications of cloud computing. Yuvaraj (2015)described"file sharing" services and technologies available in clouds (e.g. Dropbox) where OCLC and Google are exchanging data in the cloud to promote the discovery of library collections using Google search capabilities in a single interface, as groundbreaking innovation in cloud-based library services.

Big data ishigh-volume, high-velocity, and/or high-variety information assets that require new forms of processing to enable enhanced decision making, insight discovery, and process optimization(Hamad et al., 2022). Moreover,Ahmed and Ameen (2017)described the 5 V’s as volume, velocity, variety, veracity, and value."Volume" means big data is too large for desktop and laptop computers. "Velocity" means Blogs and microblogs produce material more quickly in the electronic and digital age like Twitter, a microblog. "Variety" is the third v which contains textual data (like blogs) and non-textual data (such as movies and photos). The fourth V is "veracity," which refers to the data's accuracy. The fifth V of big data is "value" which includes the cost of processing and turnover value. However, Blummer and Kenton (2018) illustrate that big data is related to increased access and availability of numerous sorts of data as well as the development of various data processing methods. They classified big data into three types: volume, veracity, and velocity.

Kaladhar and Rao (2018) mentioned that the application of RFID patron access the racks of books, browsing of books, payment of fines, online virtual tour of the library, and mobile alert for the collections. Mittal (2017)illustrated that RFID is the up-to-date wireless technology method that is used in library theft detection. Itoffers tracing systems that use multiple security and effective materials across the library. Aside from security, they facilitate the charging and discharging of materials efficiently.Conversely,Yoon et al. (2022) described that librarians have stated their concerns regarding the implications of new technologies like artificial intelligence, cloud computing, big data, robots, etc. in libraries.

DeWeese and Segal (2022), disclosed that a semantic web is a data network that is formally and semantically linked. Conversely, Macgregor (2008) determined thatthe Semantic Web is not a new Web, merely an extension of the current one in which data is context-specific, making it easier for machines and people to collaborate it. Sini et al. (2008)mentioned that usage

of the SKOS representation format and reasoning techniques over RDF-based information is one of the benefits of adopting Semantic Web technology. It can provide a framework for sharing similar terminology, provides a comprehensive, and flexible model that can be used to develop further ontologies, improve the functionality as well as the usefulness of these resources whenever they are accessed, and their effectiveness and accuracy are enhanced.Racheal (2020)identified the study of instant message feeds, HTML, SMS inquiry services, etc. in libraries and observed the change in the system due to emerging technologies which further creates a deep impact on the skills of librarians.

Diverse studies are available that discuss emerging technologies and their awareness, uses, and impact on the library environment. However, none of the studies has explored the comparison of public and private university librarians regarding the use of emerging technologies in providing services and the current study is established to do so.

2 Literature review

Saibakumo (2021)illustrated that awareness, adoption, preference, and readiness to incorporate emerging technologies into academic library activities, such as RFID, big data, and digital storytelling seemed to be just a few modern technologies that had been already introduced in libraries. Other recently adopted technologies in libraries include cloud computing, virtual reality, and augmented reality. The study findings ofOmehia et al. (2021)explored a significant correlation between librarians' fundamental computer skills and the use of new technologies.

Gul and Bano (2019)concluded that libraries were regularly using big data management, cloud computing, RFID,and social networking sites. However, without data mining,the Internet of Things(IoT), and artificial intelligence (AI) the smart-library concept was unable to be achieved.Moreover, smart libraries were growing smarter as a result of new technologies which improved their usability as well as user satisfaction. Conversely, Hussain and Ahmad (2021) narrated different types of facilities such as voice searching, biometrics, face recognition, a remote building of the library, automatic doors, and Dropbox. Similarly, electronic devices such as 3D printing, RFID, and machine learning are used to fulfill the demands of users. Whereas Blockchain, drones, facial recognition, robotics, virtual reality, and other technologies are being used to enhance the services in libraries. These technological trends could help the future development of library professionals and also transform the role of librarians from traditional to modern (Shashikumara et al., 2019).

Gupta (2020)revealed the IoT, connected devices, and services that fulfill the demands of academic users via linking media such as physical objects and wireless sensor networks. While Cloud computing has emerged as an essential part of these systems and improved the efficiency of library collections and administrative services. CorrespondinglyKajewski (2007)stressed to use of social media technologies such as Instant Messaging (IM), RSS feeds, podcasts, and blogs, to provide access, and advertise 24/7 delivery services to improve user interaction and access to library resources.Conversely,Bharti and Verma (2021)emphasized,the application of cutting-edge technologies in university libraries that will change the role and attitude of professionals towards the adoption of technology. Proving the preceding statements, Maideen and Oke (2019)confirmed the positive impact of emerging technologies (e-readers, e-books, cloud-based- services, augmented reality, and virtual reality) in libraries.

Various emerging technologies are being used in performing library services (user, technical, instructional, and management services). However, in line with the study's aim, the study will cover nine aspects of emerging technologiesin performing library services.

2.1 Emerging Technologies andUser Services

Augmented reality offers more support to library patrons and promotes library services (Mittal, 2017). Virtual reality is used in libraries for storytelling and augmented reality integrates all of this technology with extra information to "augment the real surroundings". Mobile augmented reality could be used to enhance physical book stack browsing, library navigation, facial recognition, optical character recognition, and identification software (Gul and Bano, 2019, Hahn, 2012).Lund and Agbaji (2018)indicated that augmented reality provides an opportunity to integrate technology at a low cost.Berryman (2012)emphasized that librarians should acquire knowledge of computer science to adopt the technical challenges of AR applications. Kaladhar and Rao (2018) mentioned that through the application of IoT, patrons can access the racks of books, receive mailing alerts, the messages when material returned back in the library, and pay fines through an online system. They can visit the library through online virtual tours and mobile alerts for new collections are also very helpful for users.Lastly, Mittal (2017) concluded that the availability of RFID wireless technology in libraries for theft detection is also very useful. It was an alternative form of an automated identification system. They offered tracing systems that used multiple security and effective materials across the libraries.

Cloud computing was primarily the storage of a library's server over the internet and these files could be accessed on multiple devices such as Dropbox, Office 365, and Google Drive, allowing users to check their email and services from any computer or device and backup their files. In libraries, OCLC and World Cat were the most often used servers for storing data and exchanging library materials (Kutty, 2019). Dutt (2015)concluded that cloud computing became popular due to advancements in the internet. However, cloud computing was still emerging and had the potential to be highly beneficial to libraries. However,librarians frequently reported that they found it challenging to handle the technology due to their lack of expertise in emerging technologies. Yuvaraj (2015)identified appropriate open-source cloud-based security solutions to address these issues and explored why libraries hadn't yet adopted cloud computing. For the storage requirements of libraries, there was no visible service provider that could fully meet their needs. Although Google Drive and SkyDrive offered more storage space, they were incompatible, as they only worked with Windows or Android operating systems. On the other hand,Sivankalai (2021)disclosed that while Dropbox lacked storage space, it was the compatible storage option in terms of accessibility. Cloud computing has raised significant privacy and security concerns especially when dealing with sensitive data such as the credit card of consumers. Data loss was also a possibility due to insufficient backup and system failure. Therefore, creating and utilizing cloud services requires security and privacy(Popovic and Hocenski, 2010).

Tella et al. (2020)indicated that perceived security and maintenance were good determinants for cloud computing adoption. The study results showed a relationship between the cloud computing adoption for web-based services, enabling circumstances, perceived advantages, user-friendliness, user satisfaction, security, maintenance, flexibility, and reliability.However, the study of Sivankalai (2021)illustrated that all library collections, systems, and services will be cloud-based in the next five years. Yuvaraj (2015)described "file sharing"

services and technologies were available in clouds (e.g. dropbox) world Cat local, where "OCLC and Google were exchanging data in the cloud to promote the discovery of library collections using Google search capabilities in a single interface," was a ground breaking innovation in cloud-based library services.

2.2 Emerging Technologies andTechnical Services

Linked data is structured data connected semantically using the resource description framework (RDF), uniform resource identifier (URI), and other World Wide Web Consortium (W3C) specifications. Moreover,the Semantic Web is based on Linked Data and realized through a series of W3C standards likeURI, RDF, RDF/XML, ontologies, and SPARQL" (Li et al., 2016).However, Neish (2015) described that linked data could improve search results and make resources easier to access by exposing related data for collection. Projects involving linked data performed best within a specific user community. However,many linked data technologies are complex to use and not yet ready for general use. Similarly,Raza et al. (2019) stated that Web 1.0 was informational-based, Web 2.0 was dynamic, and Web 3.0 was machine-readable which had been referred toas a Web of Data or a Semantic Web—were already available. Broad adoption of linked data technologies also contributed to the semantic evolution of the web. However,Gonzales (2014) identified that the utilization of linked data was not merely advantageous to users but the benefits of exchanging metadata and other resources were probably expanded for libraries. It would be unnecessary to duplicate data that was already accessible from trustworthy sources elsewhere library metadata was made available for reuse. According to Warraich et al. (2021), in the evolution of the World Wide Web which is known as the semantic web, computers and people collaborated to create meaningful information. It was often known as the "web of data" since it made use of integrated data technologies and made it possible to link and publish items on the web.

When used with AACR2, MARC worked well as a display standard but it was not able to display or link resources based on RDA's definition of entity relationships. As a result, LC started the BIBFRAMEinitiative to find a MARC replacement. This concluded in 2012 with the release of BIBFRAME Editor and associated tools by LC and Zepheira, Inc. (Li et al., 2016).El-Sherbini (2018)compared it with MARC 21, BIBFRAME claimed to accommodate RDA and its vocabulary appeared in a better form. The utilization of BIBFAME is still being researched. As a result, libraries could use BIBFRAME to establish an environment where they could produce datasets that could stand alone or could be linked with other datasets. According toMcCallum (2017), the vendors who provided the majority of the services have started to investigate linked data, so this is a significant development. Therefore,Raza et al. (2019)identified that the development of BIBFRAME is the best invention for libraries to distribute their metadata and information resources on the Web. Using linked data technologies, BIBFRAME promoted data interoperability and provided links between metadata elements and the semantic web.

2.3 Emerging Technologies andInstructional Services

In the past, current awareness services (CAS) kept users up to date with the latest literature and alerted library users about new acquisitions in libraries. Only a few libraries have adopted the use of CAS and selective dissemination of information (SDI) delivery, while the majority of libraries have resorted to traditional techniques. On the other hand, selective dissemination of information (SDI) was an effort by librarians to search databases for relevant

information for each library user (Omeluzor and Oyovwe-Tinuoye, 2017).Fourie (2003)explored that current awareness services assist users in locating and updating new information to characterize the SDI, such as conference announcements, current demand, new content, automatic notification, alert services, and email alerts.Cabonero et al. (2019)illustrated that CAS was one of the library services that facilitate and speed up access to library materials. Librarians keep the users up to date on new publications, support researchers in their studies, provide quick information to the users, and offer general information. These services were provided constantly by the librarians, and they also made required advances in delivery through the use of information technology applications, constantly encouraging more people to visit the library.Similarly,Honghai (2019) examined that SDI and CAS enhanced the efficiency of the most recent resources available in a library, enabling library users to access the information at the right time and right place, and encouraging a positive relationship between the librarians and information users.

The RSS feed was available on websites as an XML file that had one or more feeds. Library blogs, announcements, search resources, books, newsgroups, RSS-based search engines, and journals were all represented by RSS. RSS feeds quickly became effective communication tools for librarians as they utilized the web primarily to retrieve, disseminate, and update information(Wusteman, 2004). Similarly,Sarkar and Dey (2009)described that RSS feeds enable users to disseminate and republish material on the Internet. Moreover, libraries had already developed RSS feeds for users to subscribe, which included updates on new items in a collection, new services, and new content in subscription databases. Additionally, RSS offersmore than just text; it provides the capability to deliver audio, video, PowerPoint presentations, and PDF files. RSS feeds could be generated automatically by digital library software such as DSpace for a few collections.

Blansit (2006)indicated that RSS was a novel technique for delivering news to customers that was easy to understand and involved both client-side and server-side software; in many situations, it necessitated only a few changes to the current software. Correspondingly,Zhao et al. (2006) illustrated that RSS was a simple way to transfer content around other websites, widely used in news, and other organized websites, such as blogs. This solution helped in managing distributed learning resources simply and efficiently.Barman (2020)illustrated that RSS technology could be utilized efficiently in the library environment to deliver SDI and CAS services to library patrons. It helps to distribute messages or send updates to users who wish to receive them on their platform. Moreover, it is simple to use with integrated library management systems, digital libraries, library websites, or blogs with RSS feeds.

2.4 Emerging Technologies andManagement Services

The organizations applied big data to improve the structure of libraries. Therefore,Simović (2018) aimed to provide a method for managing huge amounts of differential data from many sources in smart libraries built on the Hadoop environment. She presented a smart library in the Big Data environment with the integration of a recommendation system, increasing user engagement, and offering special features for library administration. Ahmad et al. (2019)demonstrated a significant link between the abilities and competencies needed for librarians to adopt Big Data analytics in academic libraries. Additionally, they utilized a substantial amount of data for library tasks, such as data collection, storage, moderation, and evaluation. Blummer and Kenton (2018)illustrated that the provision of big data services

continued to benefit the cataloging, archiving, research, and reference abilities of librarians. Using this data presented the potential for librarians to enhance their services to support the research activities of teachers and students. Therefore, librarians could use big data analytics to assess and increase library services.

RFID provides security services inthe library for wireless communication devices. It is used for library security purposes for different types of library materials such as Dropbox, book issue returns, automatic doors, and security gates. The wireless system tags are attached to every item in the library with a unique identification (Hussain and Ahmad, 2021). Likewise,Mittal (2017) illustrated that RFID is the up-to-date wireless technology method used in library theft detection. However, Gupta (2020)stated that the Internet of Things (IoT) provides academic libraries' services more effectively. As a result, the IoT is the perfect new tool for influencing customers by providing unique, effective services more quickly and conveniently.Dhanalakshmi and Mamatha (2009)explained that an RFID based Library Management System would allow quicker delivery flow while delivering immediate and long-term benefits to the library regarding traceability and protection. Using RFID-enables modules, the RFID-based LMS enables fast book issuing, refunding, and return. Correspondingly,Renold and Rani (2013)disclosedthe three most important components of an RFID system: 1. tags 2. The reader's main function was to activate the tags, arrange the interaction sequences with tags, and transmit data through the program. 3. RFID middleware systems provide the messages, forwarding, and connectivity functionality needed to incorporate data from the device into library management software. However, Bansal et al. (2018)exposed that the IoT allowed things to obtain and transmit data across a network without human involvement by utilizing the Internet, detectors, and RFID tagging. It was adapted in different fields and remained in its early stages. Various novel solutions, including theft tracking, circulation desk, user identification, book reservation, mobile reference, virtual library, and book tracing, were recommended for library applications. On the other hand,Li et al. (2016)expressed that library users independently borrow, search, and return materials.It saved librarians' time that would have been wasted during scanning the barcodes at the time ofcheck-out and check-in.

Many mobile applications include personal services such as email, online browsing, traffic and weather reporting, movie viewing, and communicating with others. Ubiquitous is a mobile-based technology that means "everywhere," using any device in every location. It could improve library services, making them available to consumers anytime and anywhere(Alzaza, 2007). Similarly, Ocran et al. (2020) illustrated that almost every user has at least one mobile phone, which could access the library operations. The adoption of mobile phone library services illustrated the ubiquitous nature of mobile phone technology and how it facilitates learning in different ways.

Kumbhar and Pawar (2014)found that most university libraries offer mobile phone services through the reference desk, utilizing short message service (SMS) or text messaging capabilities available on all mobile phones. Patrons use these services (access to information, MS alert service, instant messaging (IM), suggesting a purchase, virtual tours, OPAC, Wi-Fi access, etc.)to receive information. Conversely, Wei and Yang (2017) illustrated that WeChat Library has become one of the most significant mobile service modes. The findings confirmed that the most frequently used services were OPAC search, borrowed, information discovery, and notifications. Numerous benefits were found in WeChat Library, including; inexpensive

development costs, automatic cross-platform service, low enrollment expense, quicker promotion, and real-time consulting. However, some libraries were offering self-checkout services through the WeChat Library.

The literature review illustrates that the use of emerging technologies is indispensable for libraries and librarians have to implement this while offering services. Diverse studies have discussed the features, awareness, use, importance, etc. of emerging technologies in libraries. However, not a single study is available which have compared the use of emerging technologies in providing services in public and private university libraries. Therefore, to fill the gap this study has been launched.

3 Statement of the problem

Gradually, technologies are elevating day by day. There is an increasing demand to adopt new technologies and provide education and training to librarians towards emerging technologies(Kajewski, 2007). Changesin the systems of libraries are due to the emergence of new technologies(Racheal, 2020). In the field of library and information science, innovative technologies have emerged and are now being used in various library sectors. However, due to various challenges, all libraries are not using these technological tools. In comparison to foreign libraries, Pakistani libraries lack these technologies(Hussain and Ahmad, 2021).

Diverse studies are available that cover the aspects of awareness, acceptance, application, adoption, trends, and impact of emerging technologies on library services(Cabonero et al., 2019, Gul and Bano, 2019, Hussain and Ahmad, 2021, Kumbhar and Pawar, 2014, Mittal, 2017, Raza et al., 2019, Saibakumo, 2021, Shashikumara et al., 2019). Some studies also highlighted the competencies and skills of librarians regarding emerging technologies(Ahmad et al., 2019, Yang and Li, 2016). However, no research has been conducted to assess the comparison of public and private university librarians regarding the use of emerging technologies in providing library services. In this way, the current research will bridge the existing gap in the literature.

Emerging technologies have momentous importance among university libraries. It would probably be helpful to support university librarians. It will not only ease the job but will enhance the accuracy and speed of the work. This study will not only help to identify the skills of the librarians related to emerging technologies but also motivate them to refresh these skills according to modern era requirements. The findings of this research will contribute to aware the librarians about emerging technologies and help them in future developments. This research will help librarians in making decisions about libraries and increase the productivity of these libraries.

4 Objectives and Hypotheses

The main objective of the study was to explore the application of emerging technologies by librarians to provide various types of services in university libraries. Therefore, for the completion of this objective following null hypotheses were developed.

- There is no significant difference exists between the awareness level of public and private university librarians regarding the use of emerging technologies in the provision of ‘user services’.
- There is no significant difference exists between the awareness level of public and private university librarians regarding the use of emerging technologies in the provision of ‘technical services’.

- There is no significant difference exists between the awareness level of public and private university librarians regarding the use of emerging technologies in the provision of 'instructional services'.
- There is no significant difference exists between the awareness level of public and private university librarians regarding the use of emerging technologies in the provision of 'management services'.

5 Research methodology

The survey research method is considered the most efficient and well-liked in the social sciences, especially in library and information sciences. Therefore, quantitative survey research design was used to conduct the study. The questionnaire was used to collect data from therespondent librarians. The population of the present study comprised librariansworking in university libraries of well renowned educational cities of Pakistan: Rawalpindi, Islamabad, and Lahore.

The questionnaire was chosen as a tool because it helps to overcome geographic distance and saves a significant amount of time, cost, money, and effort. The questionnaire was self-administered and the statements were adapted from the previous related studies. The questionnaire was reviewed by four field experts and their valuable suggestions were incorporated. The final tool consists of statements regarding emerging technologies to providefour aspects of services: user services, technical services, instructional services, and management services. Five-point Likert scale: Not at all Aware = 1, Slightly Aware = 2, Somewhat Aware = 3, Moderately Aware = 4, and Extremely Aware = 5 was used to evaluate the statements.Cronbach's Alpha coefficient of all the four constructs of the instrument was very high as user services 0.95, technical, instructional, and management services 0.94 which show strong internal consistency among the items of the construct.

The questionnaire was sent to 235 respondents through emails, post mails, WhatsApp, and personal visits out of which 218 (92%) responded. For this purpose, convenience sampling was applied. Data was analyzed using the Statistical Package for Social Sciences (SPSS). An independent Sample t-test was applied to find the difference between the public and private libraries.

6 Results

The findings of the current study illustrated the comparison ofthe awareness level of university librariansto use emerging technologies in providing services in private and public university libraries.For this purpose, an independent sample t-test was applied. The use of emerging technologies in providingfouraspects of library services: user services, technical services, Instructional services, and management services were explored.

The independent t-test results (Table 1) indicate that there was a significant difference regarding one statement i.e.'level of awareness ofkeeping users data secure and safe' between the public and private university librariansto use the emerging technologies (cloud computing)in performing 'user services' and private university professionals were significant than their colleagues,while all other statements were insignificant.The mean values of the entire thirteen statements from 3.60 to 4.17 indicate that the respondents were moderately awareofthe use of augmented reality, virtual reality, and cloud computing in performing 'user services'. The mean

Table 1. Awareness level of private and public university librarians regarding user services

S. #	Statements Level of awareness of……..	Private (n=136) Mean/SD	Public (n=82) Mean/SD	Mean Difference	p-value
1	augmented reality to support user engagement	3.73/0.95	3.61/0.81	.121	0.32
2	augmented reality to improve the technological programs	3.83/0.99	3.73/0.89	.101	0.44
3	augmented reality to use smartphones to locate books in stacks on a specific topic	3.78/1.19	3.68/0.90	.097	0.68
4	augmented reality to use cutting-edge library services	3.73/0.99	3.68/1.09	0.055	0.71
5	augmented reality to enhance the optical character recognition	3.67/1.07	3.64/0.9	0.031	0.83
6	augmented reality to enhance physical book stack browsing	3.78/1.17	3.76/1.03	0.023	0.88
7	use of augmented reality to enhance facial recognition	3.61/1.10	3.60/1.02	0.007	0.94
8	virtual reality to use for online virtual tour of the library	4.17/1.18	3.97/1.09	0.200	0.21
9	virtual reality to use in the library for storytelling	3.80/1.14	3.65/0.93	0.158	0.27
10	keeping user's data secure and safe	3.63/0.94	3.39/0.70	0.244	0.03
11	cloud computing in adoption for user satisfaction	4.05/0.89	3.85/0.90	0.203	0.11
12	awareness regarding cloud computing towards perceived security for users	3.80/1.14	3.65/0.93	0.150	0.26
13	cloud computing towards adoption for user-friendliness	3.88/1.20	3.76/0.91	0.113	0.44

difference (MD) of the whole statements exposed that the awareness level of librarians working in private universities was slightly higher than their counterparts. The MDs of items are shown in descending order in the table and are as under:

The MD in the level of awareness regarding augmented reality was: augmented reality to support user engagement (MD = 0.121), augmented reality to improve the technological programs (MD = 0.101), augmented reality to use a smartphone to locate books in stacks on a specific topic (MD = 0.097), augmented reality to use cutting-edge library services (MD = 0.055), augmented reality to enhance the optical character recognition (MD = 0.031), augmented reality to enhance physical book stack browsing (MD = 0.023), and use of augmented reality to enhance the facial recognition (MD = 0.007).

The MD regarding virtual reality was: virtual reality to use for an online virtual tour of the library (MD = 0.200), and virtual reality to use in the library for storytelling (MD = 0.158). The MD regarding cloud computing was: keeping user's data secure and safe (MD = 0.244), cloud computing in adoption for user satisfaction (MD = 0.203), awareness regarding cloud

computing towards perceived security for users (MD = 0.150), and cloud computing towards adoption for user-friendliness (MD = 0.113).

Table 2demonstratesthe level of awareness of universitylibrarians regarding the use of emerging technologies (semantic web/linked data and BIBFRAME) in performing‘technical services’. The independent t-test results indicate that there was no significant difference in awareness level exists betweenpublic and private university librarians to use the semantic web/linked data and BIBFRAMEin performing 'technical services'.The mean values of thetestimonials from 3.51 to 3.95 indicate that most ofthe respondents were moderately aware, and mean values from 3.31 to 3.48 indicate that some were somewhat aware. The MD ofallnine statements disclosed that the awareness level of private university librarians was somewhatadvanced than their colleagues. The MD between items of semantic web/linked data and BIBFRAME are shown in descending order as under:

Table 2. Level of awareness of university librarians towards technical services

S. #	Statements Level of awareness of……..	Private (n=136) Mean/SD	Public (n=82) Mean/SD	Mean Difference	p-value
1	semantic web/linked data to make library metadata available for reuse	3.71/0.98	3.46/0.92	0.251	0.06
2	semantic web/linked data to use as an extension of Web 3.0	3.48/0.94	3.39/0.73	0.086	0.45
3	semantic web/linked data to enable the linking of entities on the web	3.73/0.92	3.71/0.98	0.026	0.84
4	semantic web/linked data in accessing relevant material for collection	3.68/0.88	3.66/0.89	0.021	0.87
5	BIBFRAME used in place of MARC	3.95/1.20	3.73/0.98	0.232	0.14
6	BIBFRAME in accommodating RDA vocabulary	3.66/1.15	3.46/0.88	0.203	0.15
7	BIBFRAME data model	3.51/1.34	3.31/0.81	0.203	0.17
8	BIBFRAME in linking with other datasets	3.66/1.25	3.31/0.97	0.048	0.75
9	BIBFRAME, to promotes data interoperability	3.48/1.13	3.44/0.88	0.034	0.81

The MD of statements of semantic web/linked data to make library metadata available for reuse (MD = 0.251), use as an extension of Web 3.0 (MD = 0.086), enable the linking of entities on the web (MD = 0.026), and accessing relevant material for collection (MD = 0.021). The MD of statements of BIBFRAME were: BIBFRAME use in place of MARC (MD = 0.232), BIBFRAME in accommodating RDA vocabulary (MD = 0.203), BIBFRAME data model (MD = 0.203), BIBFRAME in linking with other datasets (MD = 0.048), BIBFRAME to promotes data interoperability (MD = 0.034).

The findings of the awareness level of university librariansregarding the usage ofCAS and RSS feedsin the provisions of‘instructional services’ are illustrated in Table 3.The results illustrate that the private university librarians were significantly better (among ten out of eleven statements) than their counterparts at using the CAS and RSS feed in performing 'instructional services'. The mean values of the items from 3.40 to 4.39 indicate that the

respondents were moderately aware of the ten statements however they were somewhat aware regarding only one item.

Here again, the MD of the ten statements disclosed that the awareness level of private university librarians was marginally advanced than their counterparts. The MD of the level of awareness of CAS statements: CAS in updating new information by email alerts,CAS in updating information to users about their demand from the library, CAS in updating new information about conference announcements, andCAS to alert library users about new acquisitions in the library were 0.710, 0.479, 0.420, and 0.272 respectively.

Table 3. Level of awareness of librarians towards instructional services

S. #	Statements Level of awareness of……..	Private (n=136) Mean/SD	Public (n=82) Mean/SD	Mean Difference	p-value
1	CAS in updating new information by email alerts	4.32/0.95	3.60/0.89	.710	0.00
2	CAS in updating information to users about their demands from the library	4.18/0.82	3.71/0.89	.479	0.00
3	CAS in updating new information about conference announcements	4.15/0.92	3.73/0.90	.420	0.00
4	CAS to alert library users about new acquisitions in the library	4.18/0.99	3.91/0.99	.272	0.05
5	*RSS feed* to use with digital libraries	4.39/0.83	3.59/0.87	.798	0.00
6	*RSS feed* to use with integrated library management systems	4.18/0.74	3.59/0.83	.590	0.00
7	*RSS feed* to use with library websites	4.01/0.90	3.61/0.87	.397	0.00
8	*RSS feed*, available on the websites as an XML file	3.77/1.25	3.40/0.77	.368	0.00
9	*RSS feed* generated automatically by digital library software such as DSpace	3.95/0.92	3.68/0.96	.277	0.04
10	*RSS feed* in updating current information	3.99/1.09	3.77/0.81	.217	0.09
11	*RSS feed*to enable users to disseminate the material on the Internet	4.02/0.93	4.01/0.90	.026	0.04

The MD of the level of awareness of *RSS feed* statements: *RSS feed* to use with digital libraries, *RSS feed* to use with integrated library management systems, *RSS feed* to use with library websites, *RSS feed* available on the websites as an XML file, *RSS feed* generated automatically by digital library software such as DSpace, *RSS feed* in updating current information, and *RSS feed*to enable users to disseminate the material on the Internet were 0.798, 0.590, 0.397, 0.368, 0.277, 0.217, and 0.026 respectively.

The findings of the t-test (Table 4) explored that no significant variance exists between the librarians of private and public universities regarding the usage of emerging technologies in performing "management services". The mean scores of the whole thirteen statements demonstrate that most respondents were moderately aware of providing emerging technology based 'management services' however in meager, cases they were somewhat aware. The MD of whole statements disclosed that private university librarians were slightly more advanced than their counterparts.

The MD of big data statements were: big data in utilizing a large amount of data for analysis (MD = 0.139), big data in utilizing a large amount of data for storage (MD = 0.099), andbig data in utilizing a large amount of data for collection(MD = 0.067).The MD of cloud computing statements:Cloud computing for the storage of library files through Cloud storage(MD = 0.218), Cloud computing for the storage of library files through Office 365, andCloud computing for the storage of library files through Google Drive were 0.218, 0.145, and 0.095

Table 4. Level of awareness of librarians towards management services

S. #	Statements Level of awareness of……..	Private (n=136) Mean/SD	Public (n=82) Mean/SD	Mean Difference	p-value
1	big data in utilizing a large amount of data for analysis	3.72/1.02	3.58/0.90	0.139	0.14
2	big data in utilizing a large amount of data for storage	3.80/1.08	3.71/0.80	0.099	0.09
3	big data in utilizing a large amount of data for collection.	3.78/1.00	3.71/0.86	0.067	0.15
4	Cloud computing for the storage of library files through Cloud storage	4.09/1.05	3.87/1.01	0.218	0.18
5	Cloud computing for the storage of library files through Office 365	3.94/0.99	3.85/0.99	0.145	0.3
6	Cloud computing for the storage of library files through Google Drive	4.07/1.01	3.98/0.94	0.095	0.39
7	RFIDto use for book issue/return	3.32/0.74	3.13/0.79	0.185	0.95
8	RFIDto use for automatic doors	3.39/0.90	3.28/0.98	0.111	0.42
9	RFIDto use for security gate	3.77/0.95	3.66/0.92	0.107	0.46
10	RFIDto use for Dropbox	3.37/0.72	3.27/0.94	0.094	0.43
11	mobile based library services to provide message alert service, instant messaging	3.54/0.84	3.35/0.94	0.184	0.49
12	mobile based library services to offer mobile phone services through the reference desk	3.55/0.88	3.37/0.99	0.181	0.44
13	to use the WeChat library	3.43/0.80	3.33/0.89	0.096	0.62

respectively.

The MD of RFIDstatements were: RFIDto use for book issue/return (MD = 0.185), RFIDto use for automatic doors (MD = 0.111), RFIDto use for security gate (MD = 0.107), and RFIDto use for Dropbox (MD = 0.094). The MD of mobile based library services statements were: mobile based library services to provide message alert service, instant messaging (MD = 0.184), mobile based library services to offer mobile phone services through the reference desk (MD = 0.181), and to use WeChat library (MD = 0.096).

7 Discussion

The current study illustrates a comparison of private and public university librariansin three renowned cities (Lahore, Islamabad, and Rawalpindi) of Pakistan regarding the use of

emerging technologies in providing diverse library services. The independent t-test is applied to gauge the above phenomena. The findings indicate that a significant difference exists between the librarians of private and public universities regarding the use of CAS and RSS feed in performing‘instructional services’. However, no significant variance exists regarding their provided user, technical, and management services. Moreover, mostly private and public sector university librarians are moderately awareofthe use of emerging technologies in providing library services; however, in meager cases, they are somewhat aware. The outcomes also expose that in all cases except one, private sector university librarians are slightly/significantly better than public university librarians in terms of providing library services. The findings are analogous to the results ofAhmed (2017); Awan et al. (2008); Rehman (2012); and Shoeb (2011) who pointed out that generally, private ULs were much skilled in offering services to clients. The discussion regarding the four factors of library services is as under:

Virtual and augmented reality technologies not only enhance the organization of library spaces but also provide innovative ways for users to access information and engage with digital resources.The results explore that no significant variance exists between the librarians of private and public universities regarding the usage of augmented reality, virtual reality, and cloud computing in performing ‘user services’. Both the respondents are moderately aware of the use of emerging technologies in providing ‘user services’.The MD of whole thirteen statements regarding the use of emerging technologies (cloud computing, AR, and VR) in performing user services, shows that private sector university librarians are slightly better than their counterparts in all cases.This emphasizes the importance of ongoing training and development for librarians to effectively integrate these technologies into library services and enhance user experiences. The results may be due to the pressure of job security which forces them to seek emerging technologies to perform‘user services’ in a better way. Contrarily, the job of public university librarians is secure so most of them do not try to learn new things.The above discussion confirms the 1st hypothesis istrue. The mean scores of both respondents are approximately less than four meaning a lower level of awareness. Therefore, respondents have to enhance their knowledge regarding cloud computing, VR, and especially AR to support‘user services’ more effectively.

The use of Semantic Web/Linked Data and BIBFRAME in technical services within libraries presents a transformative approach to data management, sharing, and user access.The findings expose that most of the respondents are moderately aware and some are somewhat aware regarding the usage of semantic web/linked data and BIBFRAME in performing ‘technical services’ in libraries.Librarians may use BIBFRAME to establish an environment where they link it with other datasets.The results explore thatprivate university librarians are slightly more aware than their peers working in public universities inall the statements of semantic web/linked data and BIBFRAME(Table 2). Moreover, the results indicate that no significant difference in awareness level exists between the above mentioned respondents to use the semantic web/linked data and BIBFRAMEin performing 'technical services' in libraries.The above debate proves the 2nd hypothesis true. The outcomes indicate that librarians, especially public university librarians have to increase their deficient skills likeawareness level in the BIBFRAME data model, linking it with other data sets, and promoting data interoperability.

The utilization of CAS and RSS feeds in instructional services within libraries is crucial for enhancing information delivery and improving communication with library users which ultimately contribute to the overall quality and effectiveness of library services. The findings

related to the use of CAS and RSS feeds in performing 'instructional services' illustrate that respondents are moderately aware of this concept. Moreover, outcomes illustrate that librarians of private universities are considerablymore aware than public university librarians concerning RSS feed and CAS (Table 3). The findings demonstrate that a significant difference exists (among ten statements out of eleven) between the private and public university librarians regarding the use of CAS and RSS feeds in performing 'instructional services'. These results prove the 3rd hypothesis false. The RSS feed and CAS awareness levels of both university librarians areweak, especially the public university librarians. Therefore they have to upgrade themselves regardingthe RSS feed available on the websites as an XML file, to use it with library websites, digital libraries/software, and integrated library management systems. Overall, university librarians have to upsurge all the above skills to become relevant in this era of information explosion.

The amalgamation of big data, cloud computing, RFID technology, and mobile-based services in library management services is instrumental in modernizing library operations in an increasingly digital age and librarians must have these skills.The findings regarding the usage ofbig data, clouding computing, RFID, and mobile based library services in performing 'management services' show that private university librarians are slightly more aware than their counterparts regarding whole subdivisions ofcloud computing, RFID, mobile based library services, and big data (Table 4).These outcomes are similar to the findings of Khan et al. (2018)who disclosed that private university librarians were better than their counterparts in performing 'management services'.The independent t-test confirms that no significant variance exists between the private and public university librarians regarding the usage of emerging technologies in performing 'management services'. These findings are aligned with the findings of Khan et al. (2018)who also found no significant difference between private and public university librarian's management practices. These results confirm the 4th hypothesis correct. The findings confirm that respondents possess suitable skills regarding these emerging technologies however public university librarians have to expand their skills to use RFID for book issues/returns, automatic doors, security gates, and Dropbox. However, both have to increase their mobile based library services because it enables users to reach library resources at any time and from any location.

8 Conclusion and Recommendation

The study aims to gauge the use of emerging technologies in performing library services. The findings reveal that most of thelibrariansare moderately awareof this fact.However, private university librarians are more capable in the use of emerging technologies to perform library services than their peers in all categories. This may be the cause of their job insecurity. There is no significant variance between the MDs of both university librarians regarding the use of emerging technologies in performing user, technical, and management services. The outcomes prove the 1st, 2nd, and 4th hypothesis true. However, there is a significant difference exists between the usesof emerging technologies in performing 'instructional services' which confirms the 3rd hypothesis false.

Although both librarians have showna good awareness level in using emerging technologies however it is recommended that there is also a need to enhance this competency more and the above services should be focused on improving their library structure and

providing more services for users. Moreover, libraries in public universities should conduct more training and orientation sessions to make librarians aware of new technologies.

This study is limited to public and private university librarians of three major cities of Pakistan and convenience sampling was used to collect data. So, this may be the limitation of the study.Therefore, the results may not be generalized and applicable to less developed cities of Pakistan.In the future, similar studies (practically/theoretically) may be conducted in other cities/provinces of Pakistan as well as abroad to check any relevance.

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