Mobile Apps–Based Applications in Libraries and Information Centers: A Systematic Review of the Literature and Future Research Agendas

B. P. Singh and Margam Madhusudhan

Abstract:

Due to the worldwide rapid adoption of mobile-based applications in libraries to foster the delivery of information services on mobile devices of library users, there are vast and growing collections of peer-reviewed research and conference papers available in various online databases. Analyzing the literature related to mobile-based library services is one method to conduct future research to enhance library collections and services in the digital age. The primary goal of this paper is to review the most relevant literature in the field to better understand these previous research works, identify trends and to determine the research gaps for future studies. A comprehensive and systematic review of the literature on mobile-based applications in libraries and information centers of peer-reviewed research papers, and conference proceedings published in online databases (ProQuest-LISA and Web of Science) during the last seven years (2015–2022) was conducted for critical analysis and to address the present trends of mobile-based applications in these studies. We identified that many studies have described the use of mobile apps–based applications like Mobile Online Public Access Catalogue (MOPAC), Mobile websites, Mobile databases, WhatsApp, SMS, RSS, and Quick Response (QR) Codes in the enhancement of library collections and services around the globe. We observed that 75.93% of documents were published as research articles, and 42.59% of publications were identified under the two authorship patterns. Also, the authors investigated the current and future state of the research in this field by synthesizing the results of published high-quality experimental studies and systematic mapping studies on related disciplines. We hope that this study will be helpful for librarians and information professionals to better understand and implement the applications of mobile technologies for enhancement of library collections and services in the virtual world.

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ABSTRACT

Due to the worldwide rapid adoption of mobile-based applications in libraries to foster the delivery of information services on mobile devices of library users, there are vast and growing collections of peer-reviewed research and conference papers available in various online databases. Analyzing the literature related to mobile-based library services is one method to conduct future research to enhance library collections and services in the digital age. The primary goal of this paper is to review the most relevant literature in the field to better understand these previous research works, identify trends and to determine the research gaps for future studies. A comprehensive and systematic review of the literature on mobile-based applications in libraries and information centres of peer-reviewed research papers, and conference proceedings published in online databases (ProQuest-LISA and Web of Science) during the last seven years (2015–2022) was conducted for critical analysis and to address the present trends of mobile-based applications in these studies. We identified that many studies have described the use of mobile apps–based applications like Mobile Online Public Access Catalogue (MOPAC), Mobile websites, Mobile databases, WhatsApp, SMS, RSS, and Quick Response (QR) Codes in the enhancement of library collections and services around the globe. We observed that 75.93% of documents were published as research articles, and 42.59% of publications were identified under the two authorship patterns. Also, the authors investigated the current and future state of the research in this field by synthesizing the results of published high-quality experimental studies and systematic mapping studies on related disciplines. We hope that this study will be helpful for librarians and information professionals to better understand and implement the applications of mobile technologies for enhancement of library collections and services in the virtual world.

Keywords: Libraries, Mobile apps, WhatsApp-Based services, Mobile library services, Smartphone, Mobile library websites, MOPAC, Review of literature, QR codes
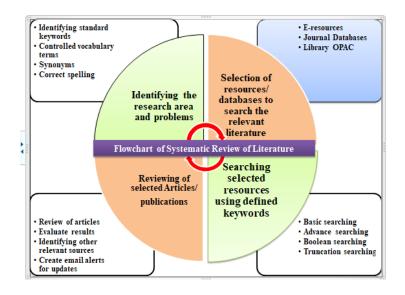
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INTRODUCTION

The mobile app is known as a short form of "mobile software application." Mobile applications or "apps" became available to download on a mobile device in 2008 (Donker et al., 2013). Since then, their use has increased rapidly, and it is anticipated to continue rising in the mobile world. As of June 2022, an estimated 2.65 million apps are available on the Google play store, but library-related apps are limited to the enhancement of library services in the virtual world. Mobile-based applications in libraries help provide e-information services to users on their mobile devices. These services can comprise two categories: the first is those traditional library services modified to be available via mobile devices, and the second is those created for mobile devices. To provide remote access to library collections and services on users' mobile devices, mobile technologies have become authoritative for libraries and information canters. Mobile device companies and computer scientists define "mobile apps" differently. A significant and straightforward definition is "A small application that runs on a Smartphone and a tablet is called the app" (J. Han et al., 2020*).*

The mobile applications for libraries look similar to library automation in the late 1980s and early 1990s. When computer applications were introduced into the library system in a few library operations like acquisition, circulation, and serials management, OPAC was implemented as isolated computer applications for libraries. Various app development tools and mobile technologies are currently used to develop mobile apps for different operating systems such as Android and Windows. For Android app development, mostly JavaScript was used, while Apple apps are typically developed using the X-code and deployed to iPhone, iPod Touch, or iPad.

A review of the literature is a pathway to conducting future research in a related area. Fostering the growth of mobile applications for enhancement of library collections and services spans various mobile-based applications in libraries and their operational practices. The latest research and practical examples are evaluating and optimizing library websites, collections, and services for mobile access anywhere, anytime over the networks. The flowchart of the systematic review of the literature is shown in below Figure 1.

Figure 1

Flowchart of Review of Literature

OBJECTIVES OF THE STUDY

The objective of the study is to present a comprehensive review of the literature on the type of mobile applications reported in libraries and information canters. The review also aims to assess the quality of the reviewed studies and current research trends. The other objectives of this study are as follows:

1. The primary objective of the study is to systematically review the available literature in areas of mobile-based application in libraries to identify the current trends of research in across the globe.

2. To find out which mobile-based applications and services have been reported so far in libraries.

3. To observe the available publication types where the most literature was published on mobile-based applications in libraries.

4. To find out the preferred document type, authorship pattern, and growth of publications in the last seven years in the area of mobile-based services in libraries.

5. To determine the research gap and future research agendas in the study area through depth analysis of the available literature.

RESEARCH METHODOLOGY

The process of a systematic review of the literature and the methodology adopted have been discussed in a standard format. A total of 51 documents (excluding websites) published in the last seven years (2015-2022) were considered for the comprehensive review and analysis. These documents included research articles, conference proceedings, and books chapters. All the documents have been retrieved through the databases Web of Science, LISA, and Scopus. The literature has been included through observation and depth analysis of content of the available literature. The methodology of this systematic literature review is presented in Figure 1 as a flowchart. Many articles were published on mobile technology applications in library services, but the scope of this systematic review study is limited to covering ten specific areas of selected studies containing the following: (1) app-based applications in libraries, (2) mobile-based applications in libraries, (3) mobile apps, (4) applications of WhatsApp in libraries, (5) Application of smartphones in libraries, (6) quick response (QR) codes in libraries, (7) SMS-based library services, (8) mobile websites in libraries, (9) mobile databases in libraries, (10) mobile technologies in libraries.

REVIEW OF THE LITERATURE

To conduct a systematic review of the literature, the first step is to collect all the publications from the selected sources (databases). These publications were identified by searching the ProQuest-LISA, Web of Science, and Scopus. The search strings used during these searches were "mobile applications in libraries," "mobile library websites," "use of WhatsApp in library services," "MOPAC," "mobile databases," "QR code applications in libraries" and "apps-based applications" and "use of mobile applications in libraries." The above-mentioned databases and journals were selected as being the latest and most relevant sources.

There are many peer-reviewed research papers existing on various facets related to mobile technology applications for the enhancement of library collections and services. The scope of this study is limited to peer-reviewed articles and research papers, which were published in various reputable international and national journals by Indian and foreign authors during the last seven years. The reviewed articles are focused on comprehensive reports, which were published worldwide, keeping in view the seminal results coming out of the relationship between mobile technologies and modern libraries. The review of relevant articles and research papers are presented below.

Mobile Library Services

Madhusudhan & Dar (2017) explored the "mobile library services initiated and adopted by university libraries for quickly mobilizing the library services as a new way to information delivery." Saravani & Haddow (2017) interviewed 42 library professionals and analyzed the level of awareness and skill requirements for implementing mobile technology (m-tech) advancements in libraries. The researchers found high awareness of the impact of m-tech applications on library services and noticed major factors to accepting m-tech on both the organizational and individual levels. Kubat (2017) examined the survey results of the future of mobile applications in university libraries in Turkey. He noted that Turkish university libraries

used a comparable level of mobile technology to offer mobile library services, like short messaging services (SMS), mobile device-enabled services, mobile websites, mobile library catalogues, chatboxes, consultations through instant messaging, mobile augmented reality,QR code applications, etc.

In his study, Singh (2018) focused on mobile-oriented library services, including a mobile app, library app, mobile library website, MOPAC, and mobile databases. It has been found that 72.34% of Central University Libraries (CUL) in India provide a mobile OPAC, 74.47% of CUL provide digital repository services and only 23.40% of CUL provide mobile services to users over the networks.

Dar (2019) concentrated on the initiatives of mobile library understanding among different categories of students. He showed that a large number of students agreed to adopt mobile library services as new initiatives for instant accessibility of their daily informational needs. This study focuses on innovative services with Web-based library services and moves into mobile library services. Mansouri & Soleymani (2019) observed that services such as searching databases, renewing/reservation of reading materials, circulation, mobile reference service, ask a librarian, library tours and instructions were frequently used by the users in academic libraries while the services of search, search using barcode scanners and databases were mostly used in public libraries.

Ocran, Underwood & Arthur (2020) proposed strategies for implementing mobile applications in library services. They investigated the preparedness of the library to implement mobile library services at the University of Cape Coast. They presented a positive perception regarding the implementation of mobile library services for enhancement of library collections and services. This study showed that most students had at least one mobile device used for 24/7 online access to library services. They also recommended that library professionals be highly trained in implementing mobile technology in their libraries.

Yi, Barun & Donghun (2022) proposed a model for mobile curation services in academic libraries. They discussed the development of mobile library services with the key modules as prototype curation services like My Page, My Log services, SMS notifications and live chat for the academic libraries. They described the concept of content curation using mobile technologies to fulfill the users' information needs.

St. Patrick's Duncan (2021) discussed the mobile library services which were provided for students' daily information needs at the University of the West Indies, Mona Campus. He highlighted that mobile library services are available with the touch of a fingertip. In this study, the author also explored mobile services to enhance the usage of library collections and services, as well as best practices for implementing mobile library services in academic libraries

Mobile Library Apps

Maideen (2017) focused on the various kinds of software and apps used as mobile technology in libraries. Sharma and Madhusudhan (2017) discussed how mobile devices are being used by library science students and librarians.

Jumah & Dar (2019) conducted a study to access e-information resources on mobile devices in Kuwait. This study explored the academic library user needs for mobile-based library services and the technical competence of library professionals to provide services "on the go."

Digital services are rendered through digital platforms via mobile applications. Izuagbe, Ifijeh & Ilo (2021) identify digital platforms for library services as Telegram, WhatsApp, YouTube, Zoom, Messenger, and Google classroom. In line with this, Nasir (2020) reported that academic libraries in Malaysia render digital services through chat services (library WhatsApp group). Swogger & Linares (2016) defined the inherent challenges in their study of BrowZine to the development and marketing of mobile apps to library users.

Canuel & Crichton (2015) describe leveraging apps for research and learning in their study. They offer wonderful opportunities to engage researchers and students with information access in new ways with the mobile app anywhere and anytime. This survey study well-explained that academic libraries smoothly implemented and promoted mobile apps for collection development in an economical and efficient manner.

Ali & Asl (2019) focused on mobile application components for the set up and development of mobile-based library services. They also investigated the essential components required to develop a mobile app to deliver library services on users' mobile devices. Additionally, they found that mobile-based library services such as SMS notifications e-mail alerts, ask-a-librarian, information searching, databases, renewing/reserving books, automatic circulation of books through barcode/QR code scanners and e-document delivery, etc. were essential services to provide proactive library services on the users' mobile devices in all types of libraries.

Kesselman (2022) discovered the best mobile applications that are useful to develop an innovative future-forward way that supports library services. He suggested iOS and Android mobile applications in libraries for creativity and innovation for mobile services. Kaddipujar; Jacob & Kumbar (2022) examined app Inventor for Android mobile app development using the drag-and-drop approach for the library at Raman Research Institute. The researchers explore the MIT App Inventor with salient features for implementing and developing apps by librarians for their libraries. This MIT inverter-generated app helps libraries to extend their mobile-based services to its users. Ajab Mohideen, Sheikh & Kaur (2022) designed and developed a mobile app for library services using open-source software. This mobile app was developed using the Koha (an open-source library information system) and tested it through user acceptance tests and system acceptance tests by experts who observed that it is properly operational, accessible, and useful for libraries. The major features of this app were circulation, an Online Public Access Catalog (OPAC) search, patrons' personal book collections, patron accounts, librarian chat, book borrowing using QR codes, social media integration, and SMS notifications of library activities, etc.

Chautula, Harvey & Mutula (2018) studied library and information services using mobile applications in public university libraries in Malawi. They found that only one library offered library services using mobile phones. In the university libraries, reference services were provided by mobile phones, as were e-journal access, Online Public Access Catalogue (OPAC), WhatsApp, and SMS notifications. The authors describe the practical implications of mobile applications as a tool for prototype models for planning and implementation of library and information services using mobile phones in the digital world.

Central Library IIT Delhi (2023) explored and implemented mobile technologies to provide library services to the users through a mobile app on their mobile devises. These mobile-

based library services are a faster way to receive a response to simple questions that can be answered 24x7.

WhatsApp Applications in Libraries

Chaputula, Abdullah & Brave (2020) surveyed the use of WhatsApp and social media in academic libraries at Mzuzu University Library, Malawi. This study was conducted using semi-structured interviews with five library staff/librarians that worked in the reference section and implemented WhatsApp-based services in their libraries to deliver information from mobile devices. He observed that WhatsApp has been successfully used to instantly provide reference services to students and research scholars. He has analyzed several technical and service-related challenges that adversely affect the instant delivery of services to users. The authors have recommended that WhatsApp applications to instantly supply information in an efficient way for mobile devices of users at a minimal cost.

Ansari & Tripathi (2017) conducted a study on the use of WhatsApp in library and information services. In this study, they indicated that users showed a positive attitude to getting library services (SMS notifications, service information, virtual reference service, and audio-video content, etc.) over WhatsApp. A total of 91.04% of users showed interest in using WhatsApp for library services. They also observed that libraries can deliver various services over WhatsApp for better satisfaction and enhanced usage of library collections and services. Guo, Lam, Chiu & Ho (2022) explained the WhatsApp-based reference service and user satisfaction in a major academic library in Hong Kong. This study adapted the questionnaire instrument to investigate relationships between library services and users. The authors observed various opinions toward using reference services and preferred methods, including irregularity between users' frequently used methods and preferred methods.

Tung Wah College (2022) explored that library staff used WhatsApp for reference services, sharing of documents and instant replies to users' questions during library hours. The service is highly used for quick and simple questions that can be answered in a short reply.

Smartphone Applications in Libraries

Al-Sadiq (2015) describes the possibility of using smartphone applications and QR codes in information institutions. The researcher dealt with the benefits of smartphones and their potential if used with QR codes. Then she pointed out the need to use this technology in providing library services and indicated how to use it efficiently. In his study, Ebiye (2015) investigated the impact of smartphones and tablets on the information-seeking behaviour of students and staff in Bayelsa State, Nigeria. He has noticed that smartphones and tablets have made a deep impact on their education, especially concerning easy Internet access, quick browsing, saving time and cost-effectiveness for teaching and e-learning materials/e-books. Elahi et al (2016) discussed smartphone implications in educational environments. In this study, they identified the services that are possible to deliver using smartphone applications, including mobile-based library services. Sambo, Lawal & Helen (2021) examined the use of smartphones for information-seeking in Nigerian universities and found that Apple iOS was the most highly used smartphones for information-seeking and retrieval by undergraduate students followed by Google Android, Windows' Blackberry, open WebOS, MeeGo, Symbian and others. Also, the authors discovered that "factors affecting the use of smartphones for information-seeking by undergraduate students

include a poor battery, high rate of theft on campus, lack of technical experts on repairs when faulty within the campus, high cost of data subscription/Internet access." Zahr (2021) explained the utility of smartphone applications for libraries rendering academic library services.

Applications of Mobile Technologies in Libraries:

Ward, Hahn & Mestre (2015) explored that potential students are interested in mobile applications for instant access to library services, as well as assessing the e-resources for academic and research activities. Rajasekhar & Sasikala (2018) observed that, "mobile applications could support learning processes by making library resources everywhere at the same time, by bringing new users to the library through increased accessibility to the resources libraries offer, and by creating a new way to enhance connections between users and libraries." Johnson Dei (2020) studied the adoption and implementation of mobile technologies in the delivery of library services in academic libraries. He observed a "strong awareness and appreciation of mobile technology–based library services among the students and library staff." The main reason for using mobile technology is the absence of physical presence, making it easier to use. The sample respondents 174 (43.50%) strongly agreed, and 161 (40.25%) respondents from the selected study area agreed that they were using mobile technology services for academic and research purposes. Significantly few respondents disagreed,20 (5%), and with 12 (3%) strongly disagreed. 33 (8.25%) were neutral. These results are similar to the findings of the studies of Acheampong & Agyemang (2021).

Acheampong & Dei (2020) discussed the rapid growth in the usage of mobile devices, mobile broadband availability, and wi-fi connectivity in most academic libraries in Ghana. They effectively deliver m-tech-based library services to users on their mobile devices (smartphones, tablets, PDA's, iPod and e-book readers, etc). The researchers noticed that continued training and ICT skills are an essential need for staff due to the lack of trained staff for the adoption of m-tech in library services. Jakati & Kumar (2022) describe the mobile applications in libraries for fostering the delivery of information resources and services over networks. They pointed out the benefits of mobile applications in mobile libraries. Ajibade, Patrick (2022) opened mobile-responsive digital repositories and present an examination of the open access approach of institutional research output over mobile devices. The authors observed that almost all academic libraries use open-source software to develop mobile-accessible institutional repositories.

Mobile Applications in Libraries

Gunjal & Gaffar (2019) surveyed on awareness, accessibility and usage aspects of mobile applications in the library among the users of NIT, Rourkela. This study describes the awareness and purpose of accessibility, and the usage of library resources and services using mobile applications. Dinazzah & Rahmi (2022) conducted a study on mobile library applications in Indonesia's digital libraries using a descriptive and qualitative methodology to analyze the development of m-library apps in Indonesia. They found that Indonesia's digital libraries are in the progressive stage and libraries use mobile applications in their digital libraries. Researchers also found that mobile applications in all mostly- digital libraries in Indonesia are designed and developed by third-party vendors.

Mobile SMS-Based Library Services

Since the beginning of the 21st century, mobile technologies have supported mobile learning in different formats. In the mobile learning context, the most popular and stable mobile technology, "Short Message Service" (SMS) is used to send text messages on cellular phones to update users. Through mobile applications, text messaging is a cost-effective platform. Maghribi, Osman & Zainal (2017) presented a few insights to set up and implement a web-based system with Mobile SMS technology to enhance library services. This web-based system helped the library professionals to notify the library patrons through SMS notification to inform patrons about the current status of check-out/in of books, due date and reservation of books. They focused on the integration of web-based and mobile SMS in library services to enhance the work productivity and efficiency of library staff. The researchers highlighted that the delivery of SMS-based library services using mobile applications is highly beneficial for users in a cost-effective manner.

Khanim & Ahmed (2018) explore the possibility of implementing mobile SMS technology to improve the delivery of information services in academic libraries. This study was conducted to examine the library notification service for users in the University of Malay Library. They found a large number of weaknesses in the existing e-mail notification system and the essential need to implement SMS notifications for information updates regarding library services. A total of 72% of respondents face problems with notifications related to the return of books. This study also revealed that the majority of users demanded to improvements in the library notification service using mobile SMS-based notification systems in the University of Malaya Library. The authors suggested enhancement of library reference services via implementing Multimedia Messaging Services (MMS) and live chatting over mobile devices in the near future.

Mobile Library Websites

Becker (2015) defined comprehensive goals for the setup and development of a mobile library website. He explained the common goals of accessibility & discovery of e-resources, enhancing the usage of reference services, accessing patron information, information literacy, audio video tours for patrons, supporting off-campus accessibility through mobile initiatives, delivery of e-resources and raising the profile of the library as well as their working staff. Anbu K & Kataria (2015) presented a model for designing and testing mobile library websites' remote access to library e-resources and services.

Mobile Databases in Libraries

April & Rachel (2015) studied the use and compatibility of the mobile accessible database of e-resources at Adelphi University libraries in 2015 and observed that 28% of the library services were appropriate and effective for mobile use. Beg, Khan & Anjum (2022) conducted a systematic review of literature on data usages issues in mobile apps and they examined "the authors proposed three main thematic taxonomies, including architectural style, security and privacy strategies, and user-usages in the mobile app recommendation domain". In this study, the researchers suggested a set of future research to investigate and development of mobile app–based databases in the higher education and emerging research domain.

Applications of Quick Response (QR) Codes in Libraries

Viktoriya (2020) describes the applications of QR codes in libraries for the marketing of library services and products. He has explored the QR codes in two categories: dynamic and static for several uses. He noted that the prospect of QR-coding technology as a type of mobile service in libraries from the point of view as a cost-effective digital marketing means of communication is substantiated around the globe. Kadli (2020) discussed that QR Codes play a vital role in shaping and delivering different types of library services with mobile applications. He has focused on QR codes and their applications for enhancement of library services and explored the advantages (speed, accuracy, quality, and cost-effectiveness) of QR Code technology in the delivery of library services. In his study Bondarenko (2020) reviewed and analyzed the literature on QR-coding technology in domestic and foreign e-resources. He found the possibility of providing information services via QR codes in the libraries. He highlighted the advantages of QR-code technology in libraries, mainly which are easily used and cost-effective due to it being freely available on the Internet. Madzidon & Harun (2022) designed a library borrowing system using a QR Code for enhancement of library services. This QR code requires unique authentication via a registered username and password, and it will be implemented by the librarians and administrators for the users. This system was designed to make borrowing books easier and helps librarians/administrators to track the usage of library resources and services. Kharat, Nagarkar & Panage (2022) conducted a study on the implementation of QR code technology in MBA College and Institute Libraries affiliated with Savitribai Phule Pune University, Pune and Pimpri Chinchwad. The researchers observed that QR codes will be more popular in the future due to their effectiveness and library users will prefer to easily scan the QR code multiple times. Singh (2015) explained that the QR code is a powerful tool for the promotion and enhancement of the usage of library products and services with mobile devices. He suggested that every library design a QR code for the library website and other services to be easily accessible.

FINDINGS FROM REVIEWS

Through a comprehensive literature review of a select 54 articles, chapters and websites, we present the findings in descriptive form using R in different tables as displayed below.

Type of Reviewed Publication Sources

Table 1 presents the distinct types of the select documents used for the review study. Five (5) types of documents were identified where 41 (75.93%) of them were research articles from journals, 3 (5.6%) were conference papers, 5 (9.3%) were book chapters, 2 (3.70%) were books and 3 (5.6%) were library websites.
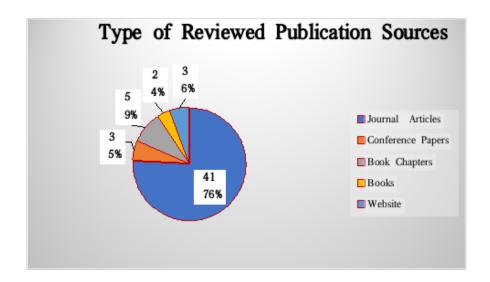
Table 1

Type of Reviewed Publications (N=54)

Document Type	Total No & Frequency 54 (100%)
Research Articles	41 (75.93)
Book Chapters	5 (9.3)
Conference Papers	3 (5.6)
Books	2 (3.70)
Websites	3 (5.6)

Figure 2 depicts the publication type-wise distribution of the reviewed articles. Most papers were published as research articles in reputable journals, followed by ProQuest-LISA databases.

Figure 2

Type of Reviewed Publication Sources

Authorship Pattern of Reviewed Publications

Table 2 summarizes different types of authorship patterns for all selected publications. Four authorship types were identified, where the highest (42.59%) numbers of publications were identified as having two authors, 27.78% of publications had single authors, and 7.41% publications had under four authors.

Table 2

Authorship Pattern

Authorship Pattern of Publications (N=51)		
S.No.	Number of Authors in a Publication	Number of Publications (%)
1.	1	15 (27.78)
2.	2	23 (42.59)
3.	3	9 (16.67)
4.	4	4 (7.41)
Total publications (Excluding Websites)		51(100)

Distribution Timeline of Reviewed Publications

Table 3 presents the yearly distribution of the reviewed publications/articles with their percentage. It was noticed that most of the searched publications were from the years 2022, 2015, 2020, 2017, 2021, 2019, 2018 and 2016. Figure 3 depicts the yearly publication distribution of the articles. Most research articles were published in Emerald database journals, followed by conference papers related to Computer Science, Library and Information Sciences.

Table 3

Distribution Timeline of Reviewed Publications

Year	Total No. of Reviewed Publications	Percentage (%)
2022	11	21.57
2021	6	11.76
2020	7	13.72
2019	6	11.76
2018	4	7.84
2017	7	13.72
2016	2	3.92
2015	8	15.69

Figure 3 shows the distribution timeline of the reviewed publications used for the study. It has been observed that most of the publications were from the years 2022, 2021, 2020, 2017 and 2016.

Figure 3

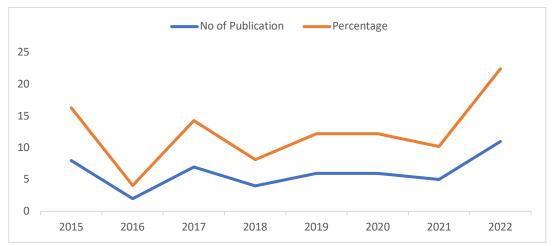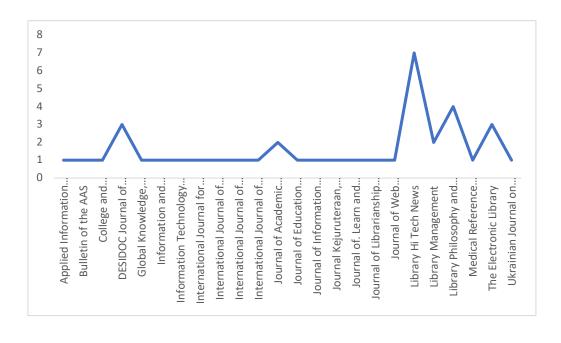*Distribution Timeline of Reviewed Publications*

Figure 3 shows the distribution timeline of the reviewed publications for the study. It indicates that the growth of publications in the select area of mobile-based applications in libraries has decreased after 2017 up to 2021. There is a growth of publications after 2021. It is worth mentioning here that 2019-2021 is the period of the COVID pandemic. The growth in publications after 2021 shows that due to the impact of the COVID pandemic, libraries highly used mobile based applications for enhancing library services.

Source of Reviewed Articles

Figure 4 shows that most of the considered articles under review were published in the journals "Library Hi-Tech News" and "Library Philosophy and Practice," followed by "DESIDOC Journal of Library and Information Technology," "The Electronic Library" and "Journal of Academic Librarianship."

Figure 4

Distribution of Articles in Different Journals

DISCUSSION AND FUTURE RESEARCH AGENDAS

The above reviews show that much has to be done in incorporating the use of mobile-based applications in the efficient and cost-effective and delivery of information services to enhance the usage of library collections and services in libraries. Most of the studies present a key role of mobile technologies in fostering library services and their significant role in reading in most parts of the developing mobile world. The results of this study show that most (75.93%) of the studies related to mobile applications in libraries measured the use of mobile-based library services and were published as research articles in peer-reviewed international and national journals. The study of Kesselman (2022) & Ajab Mohideen, Sheikh & Kaur (2022) reported the best mobile applications for enhanced library services for faster delivery of information on users' mobile devices through m-tech platforms.

Madhusudhan & Dar (2017) assert that the initiatives of mobile information services in university libraries will be a boon to creating a cost-effective information superhighway for enhancement of library collection and services worldwide. The rapid rise in mobile applications, particularly in libraries and information centers, will enable information service administrators, librarians, policymakers, scientists, academicians, and researchers to attain optimum use of library resources over mobile networks. Similar use of mobile applications also reported by previous studies by Saravani & Haddow (2017) & Ocran, Underwood & Arthur (2020) have reported that mobile-based applications in libraries help to improve information searching and mobilize library services.

This improved mobile access to information will make fostering open learning on the go a new way to get a wider spectrum of users who desire and possess the ability to actively learn using the mobile apps on their mobile devices (Acheampong & Agyemang, 2021). This study investigates the challenges faces by library professionals to implement and use mobile apps in libraries and represent the library without walls in the virtual environment. The study of Jakati & Kumar (2022), Chaputula & Mutula (2018) & Singh (2018) have presented the mobile-based applications for enhancement of library services and reported that a lack of support from institutional authorities, lack of ICT skilled manpower and funds are major problems for implementing mobile-based library services in libraries and information centers.

Due to the revolutionary growth in mobile technologies, new tools and techniques play a vital role in delivering mobile library services to users around the globe. Mobile applications are inevitable platforms of mobile communication. Currently, more and more changes in mobile applications in libraries are shifting information delivery away from web-based services to mobile-based services. Existing mobile-based library applications help to improve library services inside and outside the library itself. Further, to enhance collections and services through m-tech platforms, each library designs a mobile app to fulfil the users' informational demands on their mobile devices. The outcomes of this systematic review underscore and support the work of all authors of selected studies to process future research concerning mobile applications in libraries for enhancement of library services. We recommend thorough research on open-source mobile applications for the enhancement of library services.

CONCLUSION

This study presents an in-depth analysis and explores the significance of available literature through a systematic review on mobile app-based applications in libraries. In this study, the authors mainly review the different theoretical and practical aspects of the implementation and use of mobile apps, mobile websites, mobile databases, SMS-based services, mobile technologies, and QR codes in libraries, including the best practices, standards and advances related to mobile applications. From the perspective of fulfilling library users' needs for instant information on their mobile devices, library and information professionals are progressive in implementing mobile and QR code technologies in their libraries. The reviews of these select articles will not only guide librarians/library professionals to effectively and efficiently implement mobile applications in their libraries, but also boost the theoretical and practical approaches of mobile technologies and their implementation in libraries. Mobile-based applications in libraries such as mobile apps, mobile websites, check-out & check-in of documents, searching databases, SMS services, QR codes and enabling wi-fi Internet connection will help the libraries to satisfy the users' information needs and enhance library services and products that will provide information accurately and instantly. The COVID pandemic has forced researchers and libraries to find alternative ways of reaching remote users. Mobile technologies along with the Internet have penetrated deep into our society. By embarking on mobile and networking technologies, libraries can change the whole scenario of information access and its use. The various studies reported in this review show sample opportunities for the libraries to reach remote users and provide cost-effective services in a timely manner through mobile applications. But a critical analysis of available technologies and dynamic user behaviours by the libraries and information professionals is needed. Based on the covered research studies, the authors noted the research gap for future research possibilities. Finally, the authors suggested areas of future research directions that will be useful for potential and dynamic researchers in the applications for e the enhancement of library services in the networking environment. Therefore, more positive efforts are still needed in the development of apps-based library services to put things in perspective in the mobile world. Future works will ensure the enhancement of the usage of library collections and services in the respective libraries and information centers.

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