

REDEFINING REFERENCE SERVICES: A STUDY OF DIGITAL INNOVATIONS IN ENGINEERING COLLEGE LIBRARIES

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Abstract: In the rapidly evolving digital age, traditional reference services in libraries and information centers are undergoing a fundamental transformation. This study explores the integration of digital innovations—such as AI-powered chatbots, virtual reference desks, cloud-based access systems, and interactive knowledge platforms—into reference services to meet the changing expectations of users. The research aims to analyze how these technologies enhance information retrieval, user engagement, and service efficiency in academic libraries. This paper identifies key trends, implementation challenges, and best practices. The findings reveal that digital reference services not only extend the reach of information professionals but also significantly improve user satisfaction and accessibility. The paper concludes by emphasizing the need for continuous innovation, staff training, and policy adaptation to ensure sustainable and user-centric reference services in the future.

Keywords: Reference Services, Digital Innovations, College Libraries

1.0 Introduction

1.1 Evolution of Reference Services

Katz (2002) opined that reference services are the individualized support that librarians and other information specialists offer to users in order to help them find, assess, and make effective use of information. These services were previously provided in person at a reference desk, where the librarian would assist patrons in navigating the library's physical resources, indexes, bibliographies, and catalogue. Connecting users with the appropriate information at the appropriate moment has always been the main objective.

Desai & Patel (2016) observed that reference services grew outside of physical locations as technology advanced. The delivery model was altered by the development of the internet, online databases, and digital catalogues, which allowed services to be provided by phone, email, and eventually live chat and AI-powered tools.

1.2 Role of Reference Services in Traditional vs. Digital Libraries

In earlier times, the library's location and operating hours restricted the possibility of the need for references for printed materials. The first step for a user who needed to get in touch with a qualified librarian was to physically visit the library. People's expertise, printed indexes, and manual look-through are the first impediment; the second is the tools used to search for the resources. Although this method offers a personalized touch and goes beyond the user's request, it is incredibly resource-intensive and slow, as per Ranganathan's view (1931).

In the digital world, it is easier to provide services that make resources actively available for a user at any time of the day. Such a service is a digital reference, a tool to query a system for a printed resource. It can be accessed from wherever the user is only by using his mobile phone, laptop, or another digital device. AI-based services provide an immediate answer assisted by the modern platform, as pointed out by Lankes (2011). It is firstly faster, and secondly more scalable and further more secure for a user. The modern librarian is no more a gatekeeper.

1.3 Rationale of the Study: Redefining is Essential in the Digital Era

Kumar & Ghosh (2019) put forward the thought that the digital revolution has given us boons as well as banes. Traditional reference models are inadequate in the face of proliferation of digital resources, user behavior, and the

need for remote access. In an era of immediacy, personalization, and mobile interaction, today's users demand more than ever. Edex) In the era of digital transformation, libraries need to transform their services to be competitive and effective.

In addition, AI, machine learning, and cloud technology have given libraries a means to automate repetitive queries, study user behavior and provide personalized responses. Such innovations not only enhance service quality but also support staff in their work, was the notion provided by Patel (2020). Therefore, it is also indispensable to reconsider and reconstruct reference service supported by digital technology.

1.4 Research Objectives and Scope

This study aims to explore how digital innovations have transformed reference services in modern information centers. The key objectives include:

- To examine the various digital tools and platforms used in reference services.
- To study the effectiveness and user satisfaction of digital reference services.
- To identify challenges faced during the adoption of digital tools.

The scope of this research includes academic libraries with digital infrastructures. Through case studies. This paper attempts to assess the current status and future direction of reference services in a digitally connected world.

2.0 Literature Review

One of the major shifts that have taken place in the library and information science field during the last two decades has been the migration of reference services from the physical to the virtual realm. Early research considered the shift from face-to-face services to digital communication mediums like email and live-chat. Libraries introduced digital technologies for access, services, and effectiveness." and this line led to development of the VRS as per Tenopir (2001).

Injecting steroids into the problem, Lankes (2011) noted reference services need to move from question-answer to a participatory source of knowledge creation. The transformation of the librarian as educator and technology facilitator is one of these common themes which are found within literature when discussing the role of academic librarians in response to user movement in the digital environment.

Singh and Gautam (2020) analyzed the adoption of VRS system in Indian academic libraries and reported an upward trend in live chat tools, mobile-based apps, and social media in responding to reference queries. According to the survey, users favor the platforms that provide a prompt response and taking their ease into consideration.

In the same vein, Patel (2020), showed how chatbots could have been trained with library FAQs, database access points, citation guides, among others, to improve the first-level query resolution without the necessity of librarian's intervention. This automation enabled libraries to expand their services without a corresponding growth in the number of staff.

There are several frameworks and models to facilitate the transition to digital services. For instance, the RUSA Guidelines Reference and User Services Association (2017) provides the necessary competencies and evaluation standards for digital reference service. The key issues are immediacy, confidentiality, accuracy, and follow-up.

As introduced by Chowdhury (2010) the information interaction model is a valuable tool that focuses on user behavior, technology interface, and feedback loops. This model helps the library ensure that its systems change and adjust to the fast-changing needs of its users.

Even as much of the literature noted the potential of digital reference tools, much work remains to be done to understand user behavior in multilingual environments, the issue of data privacy in AI-powered deployments, and the challenge of sustainability in resource-constrained contexts over time. In particular, little literature has been published on the demise of the librarian's traditional skills and the organizational difficulties in train and implementation. RHDl reference remains a relatively unexplored terrain in terms of the empirical comparison of human-driven and AI-driven interactions, especially in the context of academic and research institutions in India. Thus, even as goals met this study response, our findings also suggest for further work in locally grounded, practical organizational settings for libraries

3.0 Research Methodology

This research applies a qualitative approach, focusing on semi-structured interviews with librarians to gather insights regarding their institutional actions, professional views, and experiences concerning the redefinition of reference services in the wake of digital innovations. This approach provides rich insight into the specific context within academic libraries.

To assess the practical implementation of digital reference services, the study sample consisted of six engineering colleges—three located in Mumbai and three in Pune. The selection criteria needed fulfillment of basic levels of digital infrastructure, presence of virtual reference systems, and acceptance from the referring librarian for inclusion in the study purpose. Each institution was represented by one librarian, thereby enabling six comprehensive semi-structured interviews to be performed.

Each institution was represented by **one librarian**, and a total of **six in-depth, semi-structured interviews** were conducted. These interviews focused on key themes such as **motivation** behind implementing digital reference tools, **challenges** faced during adoption and daily use, availability of **training and institutional support**, and **impact** of these innovations on user engagement and satisfaction.

The interviews provided rich qualitative insights into the **transformation of reference services**, offering both operational and strategic perspectives. The responses were recorded, transcribed, and **coded thematically**. Analysis was conducted using **NVivo software** to identify recurring themes, institutional patterns, and emerging concerns. This approach helped ensure a comprehensive and grounded understanding of the librarians' experiences across different institutional contexts.

4.0 Data Analysis

Six engineering college libraries (three in Mumbai and three in Pune) were chosen to seek a workable picture of the changing trends in reference services as influenced by digital innovation. The names from the respective institutions are protected for academic and ethical reasons, the study compares the pre- and post-innovation scenarios in each library.

4.1 Analysis of Librarians inputs in form of Interview

As part of this research, we conducted in-depth interviews with six librarians from engineering colleges. Three were based in Mumbai, and three were in Pune. The goal was to understand their perspectives, experiences, and challenges regarding the use of digital reference services.

The analysis showed that all six librarians recognized a significant change in their reference services over the past 3 to 5 years. Most mentioned that earlier reference interactions were mainly physical. Users had to go to the library desk and wait for help from a librarian. Now, with the use of digital tools like email queries, WhatsApp communication, institutional live chat platforms, and in some cases, AI-powered bots, reference support has become more accessible, timely, and user-friendly.

A common theme across interviews was the increase in query volume and diversity since digitization. Librarians noted that users now felt more comfortable asking questions remotely, especially those they might hesitate to raise in person. They also pointed out that digital platforms made it easier to assist students during exams, holidays, or while working remotely; traditional services could not handle this effectively.

Despite these advantages, librarians faced several challenges. The most frequent concern was the lack of user awareness. Students often did not know that such services existed or how to access them, which limited the impact of the tools in place. Second, technical and infrastructure problems, such as slow networks, inadequate IT support, and occasional system failures, were bottlenecks, especially in smaller institutions.

Another key issue was the need for staff training. Some librarians admitted they felt unprepared to use newer technologies like AI chatbots or video conferencing tools. There was a clear need for regular workshops or skill-building programs tailored for library staff. A few librarians also raised ethical and privacy concerns, particularly about data collected by AI or cloud-based tools, which lacked adequate institutional policies or protections.

Interestingly, while some senior staff initially resisted change, all six librarians eventually viewed digital transformation positively. They felt it had redefined their role-not as gatekeepers of information but as digital facilitators and collaborators in learning. During the interviews, librarians were asked about the need to redefine reference services in their libraries and the actions they had taken in response to digital changes. All six librarians strongly agreed that the shift was not optional but essential. They cited changing user behavior, the wide availability of digital resources, and rising expectations for instant access as main factors driving this change. One librarian noted that “students today do not wait in queues at the reference desk-they expect help through Whats App or even at midnight through AI tools.”

To meet these new demands, most librarians shared that they had introduced various digital reference services, including handling queries via email, WhatsApp, and institutional chat platforms. Two libraries had piloted AI-powered bots, while others created detailed FAQs and knowledge bases to manage routine queries automatically. Regarding institutional action, librarians confirmed they had taken clear steps toward innovation, either by proposing digital services to management, collaborating with IT departments, or conducting informal user awareness sessions.

The librarians stressed that redefining reference services involved more than just digitizing old methods; it required rethinking how they engaged with users, their service hours, and their availability. Many believed their role had expanded beyond answering questions to include building digital systems, maintaining content, and ensuring around-the-clock access. However, they also emphasized the need for institutional support, including funding, policy guidelines, and regular technical training to sustain and improve these efforts.

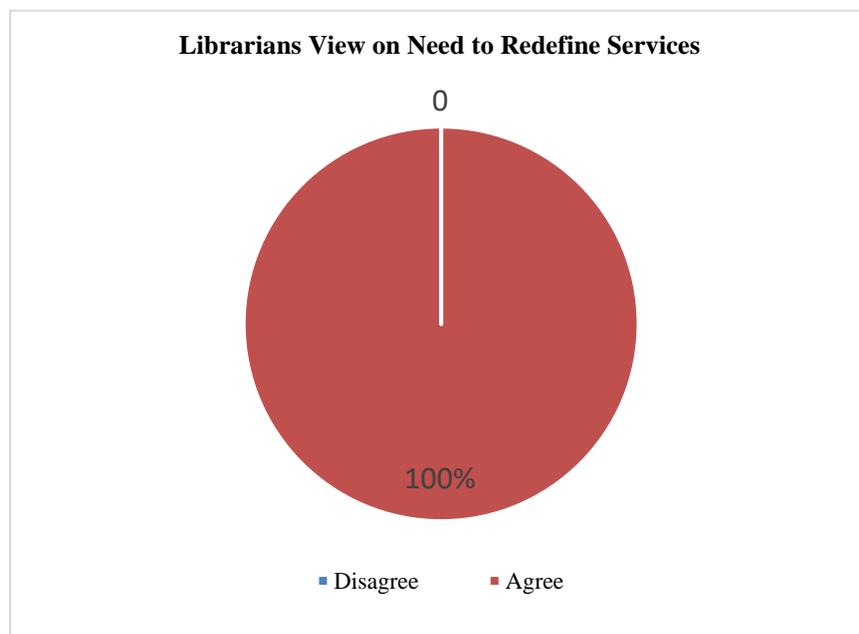


Figure 1: Librarians View on Need to Redefine Services

The pie chart clearly illustrates that **100% of the librarians interviewed (6 out of 6)** agreed on the necessity of redefining reference services in the digital age. This unanimous response reflects a shared understanding among professionals that modern users, especially students in engineering colleges, require faster, more flexible, and remotely accessible information services. The changing academic landscape and increasing reliance on online resources have made traditional reference desks insufficient, further justifying the need for innovation.

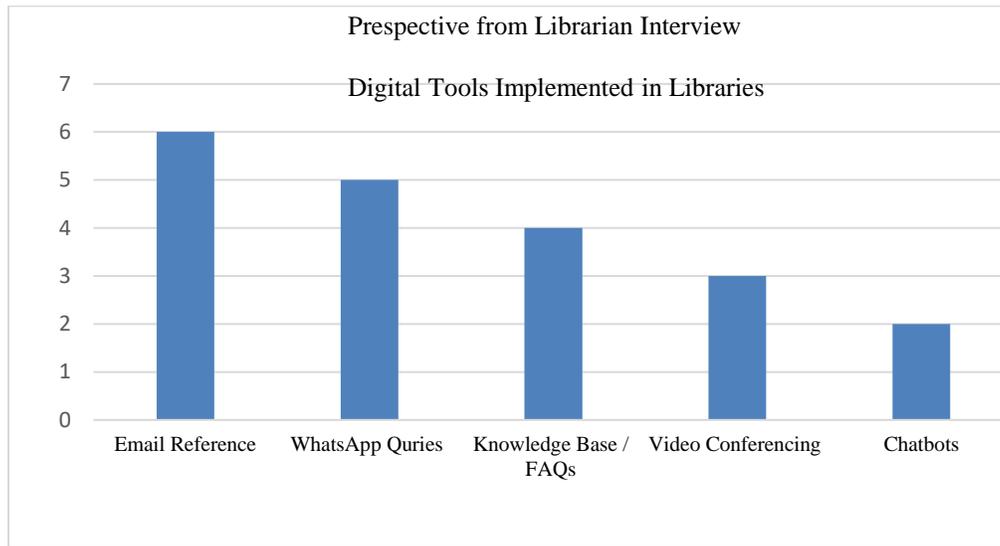


Figure 2: Digital Tools Implemented in Libraries

This bar chart shows a breakdown of the digital tools currently being used in the six libraries studied. All six libraries reported using email-based reference services, making it the most widely adopted tool. WhatsApp query handling came in second, with five librarians stating that it's highly effective for student communication. Four libraries had created online knowledge bases or FAQs to help users with repetitive or basic questions. Video conferencing tools (e.g., Google Meet or Zoom) were used by three librarians, primarily for research consultations. Only two libraries had begun using AI-based chatbots, indicating that while interest in automation exists, full adoption is still in its early stages.

This chart reflects a tiered adoption of technologies, where simpler, low-cost tools have broader implementation, while more advanced innovations require greater infrastructure and training.

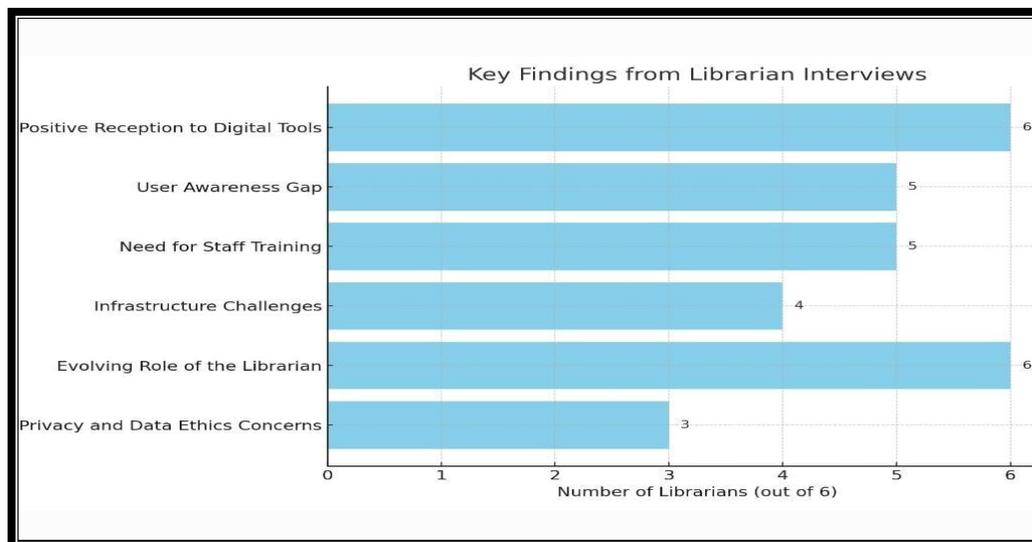


Figure 3: Common Challenges Faced by Librarians

The radar chart presents a normalized comparison of six major challenges reported by librarians during interviews. Each axis represents one of the recurring barriers, and the closer the plot reaches the outer edge (value 1), the more librarians reported that issue: Positive Reception and Evolving Role of Librarian scored highest, showing a strong professional commitment to digital change. User Awareness Gaps and Need for Staff Training also had high impact scores, confirming that while tools exist, both users and staff need orientation and support to maximize their value. Infrastructure Challenges were moderately reported, suggesting variability in IT resources across institutions. Privacy and Data Ethics Concerns were acknowledged but received the lowest concern score, likely due to a lack of formal institutional focus on these aspects-an area that still needs proactive policy attention.

This radar view highlights that technical and human-resource-related issues are more pressing than ethical or legal ones, at least in the current phase of digital transformation.

4.2 Key Findings from the Librarian Interviews

4.2.1 Positive Reception to Digital Tools: All six librarians appreciated how digital reference services improved accessibility, responsiveness, and user interaction.

4.2.2 User Awareness Gap: Most librarians observed that students were not fully informed about the availability and benefits of digital reference platforms, affecting service use.

4.2.3 Need for Staff Training: There was a consensus on the lack of formal training for library professionals in managing AI tools, live chat systems, and data handling.

4.2.4 Libraries faced issues like poor internet connectivity, insufficient IT support, and limited budgets for system upgrades.

4.2.5 Evolving Role of the Librarian: The interviews clearly showed a shift in the librarian’s role, changing from information provider to digital guide and system integrator.

4.2.6 Concerns about Privacy and Data Ethics: Librarians highlighted the absence of formal policies on how user data is stored, managed, or protected in AI/chatbot-based platforms.

4.3 Comparative Analysis: Pre- and Post-Innovation Scenario

Prior to the adoption of digital reference tools, most libraries operated through traditional models-physical reference desks, printed guides, and in-person consultations. These services were limited to library hours and required the physical presence of users and staff.

Post-innovation, libraries transitioned to hybrid models combining traditional expertise with digital platforms. This transformation included the use of AI-based chatbots, virtual desks on Microsoft Teams, WhatsApp-based reference services, and integration of FAQs and email support systems.

Table 1: Pre- and Post-Innovation Scenario

| Parameter | Pre-Innovation | Post-Innovation |
|-----------------------------|---|--|
| Mode of Access | In-person | Remote (Web, Mobile, Email, Chatbot) |
| Service Availability | Limited to working hours | 24x7 or extended hours through automation |
| Turnaround Time for Queries | 12–24 hours (depending on staff availability) | Instant for FAQs/Chatbots; < 6 hours for complex queries |
| User Engagement | Low (limited to physical visitors) | High (increased queries via digital modes) |
| Staff Workload | High, manual response to every query | Optimized, with routine queries handled by AI |
| Feedback Mechanism | Informal or unavailable | Structured via forms, surveys, or chatbot feedback |

This shift enabled better scalability and user satisfaction, especially for students who preferred asynchronous or mobile-friendly communication formats.

5.0 Challenges and Limitations

The librarian interviews conducted as part of this research revealed several key challenges and limitations in redefining reference services through digital innovations. While the overall response to digital transformation was positive, practical hurdles at the implementation level were consistently noted across all six institutions.

5.1 Lack of User Awareness :A major challenge highlighted was the limited awareness among students about the existence and scope of digital reference services. Despite introducing tools like WhatsApp queries, email support, and FAQs, librarians found that many students continued to rely on traditional interactions simply because they were unaware of modern options. This lack of awareness limited the reach and effectiveness of digital platforms.

5.2 Infrastructural and Technical Limitations:Several librarians pointed out inconsistent internet connectivity, outdated systems, and the absence of dedicated technical support staff as barriers to smooth digital service delivery. These infrastructural weaknesses particularly affected the implementation of AI tools and cloud-based systems, which require stable networks and backend support.

5.3 Insufficient Staff Training: Librarians themselves acknowledged that many professionals, especially those from earlier generations, lacked formal training in digital communication tools, chatbot integration, or even basic troubleshooting. The absence of regular training programs led to hesitation and under-utilization of available digital resources.

5.4 Budget and Resource Constraints :Budget limitations were another significant hurdle. While librarians had ideas and proposals for innovation, many were unable to secure funding for advanced platforms or external support. Free or low-cost tools were adopted in some cases, but their scalability and sustainability remained questionable without institutional investment.

5.5 Resistance to Change :A subtle but recurring limitation was resistance from library staff who were more comfortable with traditional methods. In some libraries, the shift to digital services was met with skepticism, requiring extra time and effort from head librarians to build acceptance and demonstrate effectiveness.

5.6 Absence of Policy and Ethical Frameworks : Librarians also raised concerns about the lack of institutional policies regarding user data privacy, response standards, and ethical use of AI tools. With no formal guidelines in place, many librarians operated in a grey area, unsure about how data was being stored, monitored, or shared.

These challenges, derived directly from librarian experiences, indicate that while there is a desire to transform reference services, its execution demands systematic planning, institutional support, user engagement, and ongoing professional development. These limitations also highlight important areas for future improvement and further research.

6.0 Conclusion: This research paper, titled “Redefining Reference Services: A Study of Digital Innovations in Information Centers,” examined how engineering college libraries in Mumbai and Pune are changing traditional reference services by integrating digital tools and user-focused innovations. Through interviews with six librarians and a survey of 180 students, the study provides a broad view of how reference services are evolving to meet the needs of today’s digital users.

The findings showed that all six libraries have started digital reference services, such as email consultations, WhatsApp helpdesks, AI chatbots, and institutional FAQs. However, their usage varies due to a lack of awareness among students and the readiness of staff. Librarians noted the urgent need to adopt new solutions, as student expectations are changing, remote inquiries are increasing, and there is a demand for round-the-clock access to information. Still, they face challenges like infrastructure issues, budget limits, and a lack of formal training and digital policies.

Despite these obstacles, the study highlights several success stories and emerging practices, such as hybrid models that combine AI automation with human skills, mobile-friendly access, and regular feedback systems. The role of the librarian is also changing from a passive information provider to an active digital facilitator and innovator.

In conclusion, redefining reference services in academic libraries involves not just technology but also cultural and institutional change. The success of these services depends on smart planning, staff training, user engagement, and incorporating digital thinking into library policies and vision. As the study shows, with careful implementation and institutional support, digital innovations can make reference services more accessible, inclusive, and effective.

Looking ahead, future research could examine the long-term effects of these innovations on academic performance, user engagement, and the professional identities of librarians. There is also a need to study digital reference services in rural or multilingual settings, where the challenges may be more complex but equally important to address.

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