A Study on the Optimization of Information Service Models in University Libraries in the Era of Big Data

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Abstract: Against the dual backdrop of the rapid proliferation of big data technology and the profound digital transformation of education, university libraries—as the central hubs for academic literature and information and key platforms for talent development—find their traditional information service models increasingly unable to meet the diverse, personalized and immediate information needs of today's university students. Leveraging its core strengths in massive data processing, multi-source information integration and user needs analysis, big data technology offers a novel pathway for the innovation of university library information service models. By systematically examining the core relationship between big data and university library information services, and thoroughly analyzing the difficulties and challenges faced by such services in the big data environment, this study draws upon relevant domestic practices in big data applications within university libraries. It proposes targeted optimization strategies across six dimensions — technological integration, service models, resource provision, librarian competencies, feedback mechanisms and data security, this paper proposes targeted optimization strategies. The aim is to drive the transformation of university library information services towards precision, personalization, intelligence and efficiency, thereby providing practical guidance and theoretical support for the high-quality development of university libraries, and contributing to the enhancement of talent cultivation and disciplinary development in higher education.

Keywords: Big Data; University Libraries; Information Service Models; Optimization

1. Introduction

With the rapid development of big data technology, data has become a core productive factor driving transformation across all sectors of society, and the education sector has also entered a new phase of data-driven development. As the primary hub for university students to access academic resources and conduct learning and research, university libraries bear the important mission of serving talent development and supporting disciplinary development. In the big data environment, university students' information-seeking habits and levels of demand have undergone significant changes; they are no longer satisfied with traditional borrowing and retrieval services, and have placed higher demands on the precision, convenience and personalization of information services. Currently, some university libraries continue to adhere to the traditional 'resource-centric' information service model, with the application of big data technology largely remaining at a superficial level. This situation gives rise to numerous issues, including a lack of in-depth technological application, rigid service models, a disconnect between resource provision and user needs, and insufficient staff competence, resulting in

the library's core value failing to be fully realized. Although some university libraries have taken the lead in implementing big data applications, overall, the digital and intelligent transformation of university library information services still faces numerous obstacles. Against this backdrop, conducting an in-depth exploration of the optimization pathways for university library information service models in the big data environment, and addressing the difficulties and challenges they face, holds significant theoretical value and practical significance.

2. The Core Relationship Between Big Data and University Library Information Services

2.1 The Core Value of Big Data in Empowering University Library Information Services

The core value of the deep integration of big data technology with university library information services lies in the unification of enhancing service efficiency, delivering targeted services, and expanding the scope of services. Big data technology can rapidly process vast amounts of collection and user behavior data, replacing manual, repetitive tasks and reducing the cost of information retrieval as well as the workload on library staff. By mining multi-dimensional user data to construct precise user profiles, it overcomes the shortcomings of a 'one-size-fits-all' service approach, enabling the targeted delivery of resources and services [1]. Simultaneously, by breaking down spatial and temporal constraints, it drives services to extend into deeper domains such as academic support, research assistance and literacy development, thereby establishing a comprehensive, round-the-clock information service system. This also represents the core manifestation of how big data empowers high-quality innovation in university libraries.

2.2 Application Scenarios of Big Data in University Library Information Services

Based on current practice, the application of big data technology in university libraries has formed a multi-dimensional coverage framework. In the field of resource management, some university libraries achieve targeted procurement by analyzing collection circulation and user demand data; in the field of retrieval services, some university libraries rely on big data to build 'one-stop' retrieval platforms, integrating multi-source heterogeneous resources to simplify retrieval processes and improve efficiency; in the realm of personalized services, some university libraries analyses user behavior data to deliver personalized knowledge service recommendations[2]; in the realm of information literacy training, some university libraries utilize big data to optimize training programmers, creating a 'teaching-practice-feedback' closed-loop to enhance training effectiveness.

2.3 Trends in the Transformation of University Library Information Services in the Big Data Environment

Driven by big data, information services in university libraries are undergoing a multidimensional transformation: service philosophies are shifting from a "resource-centric" to a "user-needs-centric "approach, with a focus on personalized requirements and user experience; service models are transitioning from passive response to active push, utilizing big data to deliver precise recommendations for resources and services; service content is expanding from basic borrowing and retrieval to diverse areas such as academic support, research assistance and data services[3]; service delivery is integrating online and offline channels, with online platforms built on big data to provide round-the-clock services; and service teams are transitioning towards "data-literate librarians", placing higher demands on librarians' professional knowledge and big data application skills.

3. Difficulties and Challenges Facing University Library Information Services in the Big Data Environment

3.1 Insufficient Application of Big Data Technology

The superficial application of big data technology and its lack of adaptability represent one of the core challenges currently facing information services in university libraries. In most university libraries, the application of big data remains confined to superficial levels such as 'one-stop' search and simple statistics on user behavior, lacking in-depth application of core technologies such as data mining and multi-source data integration, some universities have blindly introduced technologies and systems, resulting in a severe disconnect between technological application and service needs, rendering them unable to resolve practical issues. At the same time, the development of big data infrastructure lags behind, making it impossible to establish a comprehensive big data service platform. The systems introduced are mostly off-the-shelf commercial software, lacking targeted customization and optimization, and suffering from issues such as untimely data updates and poor compatibility. Furthermore, most libraries lack a unified data middleware architecture, making it difficult to interface with university-level data centers and academic administration systems, which in turn leads to difficulties in data integration.

3.2 Service Models Lack Personalization and Proactivity

The traditional 'resource-centric' service model is deeply entrenched, and the transition to new approaches has been slow. Many university libraries continue to rely on passive, reactive services, failing to utilize big data technology to uncover students' latent information needs. Consequently, services lack personalization and proactivity, and are unable to meet the diverse and immediate demands of university students. Whilst students' information needs exhibit distinct personal characteristics, the majority of current library services still operate on a 'one-size-fits-all' model, lacking sufficient targeting. Service scenarios have not been sufficiently expanded; the scope of services remains confined to the physical library space and has not been extended to high-frequency student activity areas such as lecture halls and halls of residence. Furthermore, there is a lack of 24-hour online data service support, making it difficult to meet students 'fragmented information access needs. In addition, the information literacy training system is inadequate; training content is monotonous and methods are traditional, making it difficult to adapt to students' fragmented learning habits, resulting in poor training outcomes.

3.3 Insufficient Digitization of Resource Provision

Resource provision lacks sufficient digitalization and is out of step with students' information needs. Most university libraries still rely primarily on traditional print resources, whilst the development of digital resources lags behind, particularly regarding the provision of structured data resources compatible with big data technologies. At the same time, there is a misconception in resource development that prioritizes quantity over quality; a large number of library collections are disconnected from student needs, resulting in low resource utilization rates. More notably, there is a lack of effective digital interconnection between various types of resources, creating 'information silos. University libraries' physical collections and digital resources, as well as on-campus and off-campus resources, remain isolated from one another, failing to achieve intelligent integration and sharing, thereby increasing the difficulty and cost of information retrieval for university students. Furthermore, cumbersome resource search processes and complex off-campus access authentication procedures

further reduce the convenience of accessing resources.

3.4 Insufficient Digital Literacy Among Librarians

The lack of digital literacy among library staff has become a core bottleneck constraining the development of big data information services in university libraries. In a big data environment, librarians need to transition towards becoming 'data-literate professionals', possessing not only expertise in library and information science but also mastery of big data-related technologies. However, the majority of current librarians have significant skill gaps; some have limited understanding of big data technologies and are unable to proficiently utilize big data tools to deliver services. Some librarians lack a service-oriented mindset and have not adopted a 'user-center' service philosophy; their communication skills and ability to provide personalized services are deficient, making it difficult for them to accurately identify students' core needs. Furthermore, most libraries lack a comprehensive training system and incentive mechanisms for librarians to develop their digital literacy; consequently, librarians show little initiative in improving their own skills and struggle to meet the service development requirements of the big data era.

3.5 Ineffective Feedback Mechanisms

Feedback mechanisms are insufficiently digitized, with channels being relatively limited. These primarily consist of offline suggestion boxes and enquiry desks, lacking online channels suited to university students' digital communication habits. This results in feedback being collected in a manner that is neither timely nor comprehensive. Furthermore, libraries fail to utilize big data technology to analyses feedback, making it impossible to pinpoint service pain points accurately. Consequently, issues are not addressed promptly, which dampens students' enthusiasm for providing feedback. The absence of user participation mechanisms makes it difficult for students to engage in the development of library resources and service optimization; furthermore, the lack of effective incentive mechanisms prevents the formation of a collaborative development framework. Additionally, the application of big data poses significant risks regarding data security and privacy protection. Some libraries lack comprehensive security management systems and protective measures, and incidents of user privacy data leaks occasionally occur, thereby reducing user trust.

4. Strategies for Optimizing Information Service Models in University Libraries under the Big Data Environment

4.1 Deepening the Application of Big Data Technologies and Improving Infrastructure Development

To address the issues of insufficient technological application and lagging infrastructure, university libraries should increase their investment in technology. By taking into account their specific circumstances and the needs of students, they should introduce core technologies such as data collection, mining and cleansing, establish a comprehensive big data service platform, and set up standardized mechanisms for data collection and processing to ensure data quality. At the same time, they should optimize technical implementation plans, conduct needs assessments in advance, strengthen cooperation with big data companies and other universities, draw on advanced best practices, and establish mechanisms for the continuous updating and maintenance of technology. Furthermore, they should seek dedicated funding to establish a unified data middleware architecture, enabling integration with university-level data centers and academic administration systems to break down data silos; introduce advanced storage and processing equipment; establish data standards and

specifications; ensure the compatibility and scalability of multi-source data; and promote the efficient integration and utilization of data resources [4].

4.2 Innovating Service Models to Enhance Personalization and Proactivity

We must break free from the limitations of traditional service models and adopt a 'student-center' service philosophy, driving a shift from 'reactive' to 'proactive' service. By utilizing big data technology to analyses user behavior data and identify latent needs, we can proactively push relevant resources and services. We should construct precise user profiles to provide personalized services tailored to students of different years, majors and academic stages, and leverage large-scale model technology to enhance the intelligence of personalized services. Expand service scenarios by extending services to high-frequency student activity areas such as teaching blocks and halls of residence. Implement embedded data services and establish a 24-hour online service platform to meet students fragmented and immediate needs. Refine the information literacy training system by optimizing training content, incorporating practical big data skills training, and innovating training methods through a "blended online and offline" approach to accommodate students' fragmented learning habits.

4.3 Optimizing the Resource Supply System to Address the 'Information Silos' Problem

Adjust the structure of resource provision to drive a transition from a "print-first, digital-second" approach to a "digital-first, print-supplementary" model. Increase investment in digital resources, prioritizing the procurement of specialized databases and research datasets compatible with big data technology, and precisely allocate resources based on students' academic requirements [5]. Utilize big data technology to break down resource barriers, strengthen collaboration with internal university departments and libraries at other institutions, join regional resource-sharing consortia, and integrate non-academic resources to meet students' diverse needs. Optimize search systems to achieve "one-stop" searching, simplify search procedures and off-campus access authentication, and enhance the convenience of resource access. Strengthen resource promotion and outreach; utilize big data technology to analyses user access habits and precisely push resources and services; establish a dynamic resource update mechanism and a self-managed development model to build a distinctive institutional collection.

4.4 Enhancing Librarians' Digital Literacy and Strengthening Service Capacity

Establish a comprehensive digital training system for library staff, organizing regular professional knowledge and big data technology training sessions. Encourage staff to participate in academic exchanges and skills training, and strengthen joint training initiatives with big data enterprises and other universities to enhance practical capabilities. Strengthen service awareness among staff by conducting service philosophy training, and cultivate communication skills and the ability to provide personalized services. Establish a scientific staff appraisal mechanism that incorporates professional competence and service quality into evaluations, thereby incentivizing staff to proactively improve their professional standards. Form a specialized data services team, clearly define roles and responsibilities, select outstanding librarians to lead the team, recruit professionals from the big data sector, optimize the team structure, encourage librarians to participate in research projects to enhance their academic research capabilities, and provide professional guidance to undergraduates [6].

4.5 Improve Feedback Mechanisms and Data Security Systems to Enhance Service Quality and Security

Integrate feedback channels to establish a digital feedback system combining 'online and offline' approaches. Utilize big data technology to construct a feedback analysis system, enabling the rapid collection and analysis of feedback to pinpoint service pain points with precision. Establish a feedback handling ledger to clarify processing procedures and timeframes, and provide timely feedback on outcomes to boost students' willingness to provide feedback and their overall satisfaction. Establish collaborative development mechanisms and user participation incentive schemes to encourage university students to participate in library development and service optimization, thereby boosting their enthusiasm for participation. Construct a three-pronged data security governance system comprising "technical defenses, institutional constraints and user empowerment". Strengthen the application of data encryption and protection technologies, establish robust security management systems, conduct regular security audits and risk assessments, and enhance data ethics education to ensure the safe and reliable application of big data.

5. Conclusions

Against the backdrop of digital transformation in education and the rapid development of big data technology, big data presents both new opportunities and challenges for the innovation of information service models in university libraries. Its core advantages can effectively address the pain points of traditional services, driving the transformation of library information services towards precision, personalization, intelligence and efficiency, thereby fully leveraging the core functions of the library. This study finds that university library information services currently face numerous difficulties and challenges: the application of big data technology is not sufficiently in-depth, and service models lack personalization and proactivity; insufficient digitization of resource provision, inadequate digital literacy among library staff, and imperfect feedback mechanisms. To address these issues, drawing on the practical experience of leading domestic universities, this paper proposes optimization strategies across five dimensions—technology application, service models, resource provision, staff literacy, and feedback and security. These strategies are highly practical and targeted, capable of driving the optimization and upgrading of university library information service models, thereby providing robust support for talent cultivation and disciplinary development within universities.

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