Research on Smart Library Service Models

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Abstract

Smart services represent the transformation and upgrading of university library services, constituting an inevitable choice for the sustainable development of university libraries. This report focuses on university libraries as the primary research subject, analyzing the current state of library smart services based on our library's reader behavior data (including borrowing data, space utilization data, access control data, WeChat platform data, etc.) across several dimensions such as borrowing services and resource construction, personalized services, and space services. It delves deeply into existing problems, thereby attempting and exploring the methods, content, and forms of library smart services respectively, and proposes relevant recommendations for fostering a favorable smart library service environment.

Full Text

Preamble

Research on Smart Service Models for Libraries
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Introduction: Smart services represent the transformation and upgrading of university library services and constitute an inevitable choice for sustainable development. This report focuses on university libraries as its primary research subject, analyzing the current state of smart library services in areas such as borrowing services and resource development, personalized services, and spatial services based on our library's reader behavior data (including borrowing data, space utilization data, access control data, and WeChat platform data). The report delves into existing problems and explores methods, content, and forms for library smart services, offering recommendations to foster a favorable smart library service environment. This report can serve as a data reference for

decision-making, extracting insights from data to prepare comprehensively for future challenges.

The data analysis results related to student behavior provide valuable references for student management. We welcome library leadership and colleagues from all departments to read and reference this report.

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Chapter 1: Smart Upgrading of Traditional Borrowing Services

Currently, university libraries have adopted various forms of smart borrowing services, primarily including self-service borrowing, mobile phone borrowing, and facial recognition borrowing. Among these, self-service borrowing is the most prevalent form of smart borrowing in university libraries, with 60.71% of double-first-class university libraries utilizing RFID technology to offer self-service borrowing. Additionally, 35.72% support mobile phone borrowing, allowing users to borrow books independently via mobile devices. Furthermore, 3.57% have implemented facial recognition borrowing, enabling users to borrow books without carrying relevant documents. However, these technological approaches have not altered the reality of declining year-over-year borrowing rates for print books. By employing big data analytics—a crucial technology for smart libraries—we can specifically deconstruct the utilization dilemma of print books and summarize trial measures for improving print book borrowing.

Big data analytics helps libraries manage massive data information resources and extract valuable insights, enabling staff to provide more accurate and higher-quality services. Through deep mining of user borrowing records, visit volumes, and behavioral data, libraries can conduct precise recommendations and personalized services centered on user needs and behavioral characteristics, thereby enhancing user experience and satisfaction. Currently, data comes from two main sources: school information system shared data and Huiwen system data.

1. School Information System Shared Data

(1) Student reader data: ID number, name, gender, phone number, reader type, college, department, grade.

(2) Faculty reader data: ID number, name, gender, phone number, reader type, college/unit, department, professional title.

2. Huiwen System Data

(1) Registration and expiration dates for all reader types.

(2) Print books: MARC record number, title, author, call number, property number, location, language, item status, circulation status, ISBN, publisher, publication year, price, acquisition date, order date, order batch, check-in date, check-in batch.

(3) Journals: title, ISSN, property number, location, language, year/volume/issue, item status, circulation status, price, document type, acquisition date, sponsoring unit.

(4) Borrowing data: title, author, publisher, publication year, ISBN, call number, location, ID number, name, gender, reader type, college/unit, grade, phone number, borrow date, return date.

(5) Electronic resources data: title, database, standard number, document type, DOI.

1.1.1 Zero-Borrowing of Print Books During Degree Programs

Using students from the 2017, 2018, and 2019 cohorts (undergraduates, master's students, and doctoral students) as examples:

Cohort	Undergrad Enrollment	Borrowed $ $1 Book (%)	Zero-Borrowing (%)
2017	91.64%	90.78%	8.36%
2018	81.50%	90.78%	9.22%
2019	-	-	8.36%

Cohort	Master's Enrollment	Borrowed $ $1 Book (%)	Zero-Borrowing (%)
2017	79.79%	79.00%	20.21%
2018	76.48%	76.48%	23.52%
2019	72.19%	70.87%	27.81%

Cohort	Doctoral Enrollment	Borrowed $ $1 Book (%)	Zero-Borrowing (%)
2017	70.56%	70.56%	29.44%
2018	-	-	29.13%
2019	-	-	29.44%

Note: Statistics cover the entire degree period. For example: 2017 undergraduates from 2017.9.1–2021.7.1; 2017 master's students (for MBA, MPA, and MEM programs with 2.5-year duration, uniformly counted as 3 years) from 2017.9.1–2020.7.1; 2017 doctoral students (spring enrollment numbers were small, so uniformly counted as fall semester, and extended doctoral students with >4-year duration were not strictly counted—extending the period would slightly reduce the zero-borrowing proportion) from 2017.9.1–2021.7.1. Similar methods apply to 2018 and 2019 cohorts.

This analysis reveals that 8%–18% of undergraduates, 20%–23% of master's students, and 27%–29% of doctoral students from the 2017–2019 cohorts did not borrow a single book during their entire degree program. If these students could be attracted to borrow at least one book, print book circulation would increase by tens of thousands. To achieve this, we can analyze book preferences by college and discipline for undergraduates, master's students, and doctoral students, then targetedly increase collections of preferred categories to improve print book borrowing rates.

1.1.2 Book Borrowing Patterns by Discipline (2022)

Statistics on book borrowing by undergraduates, master's students, doctoral students, and faculty are categorized by liberal arts, science, and engineering disciplines. Reader borrowing patterns correlate strongly with their majors. Liberal arts undergraduates, master's students, doctoral students, and faculty borrow humanities books at 56%–66%; if literature is included, this reaches 70%–85%. Science students and faculty borrow industrial technology + mathematics/physics/chemistry books at 59%–77%. Engineering students and faculty borrow industrial technology + mathematics/physics/chemistry books at 64%–83%.

To better meet student learning needs, support teaching and research, and provide comprehensive library materials, we should use circulation data analysis for high-traffic categories, strengthen communication with academic affairs offices and departments to understand curriculum plans, track faculty and student numbers by major, monitor new developments in disciplines, and targetedly meet borrowing needs across disciplines and reader types to increase circulation rates.

Note: Engineering includes: Intelligent Science and Engineering, Information and Communication Engineering, Underwater Acoustics Engineering, Computer Science and Technology, Mechanical and Electrical Engineering, Nuclear Science

and Technology, Aerospace and Civil Engineering, Power and Energy Engineering, Naval Architecture, Materials Science and Chemical Engineering. Science includes: Mathematical Sciences, Physics and Optoelectronic Engineering. Liberal Arts includes: Economics and Management, Humanities and Social Sciences, Foreign Languages, Marxism.

1.1.3 Zero-Borrowing of Collection Resources Over Five Years

Collection development is fundamental to libraries, and book resource development is one of the core long-term services. With digital, networked, and smart development, 20.20% of double-first-class university libraries have innovated traditional book recommendation and purchase models, launching personalized book recommendation platforms based on database vendor systems or self-built systems. 14.14% have launched personal library-type smart services. The core question is: how well are resources purchased through recommendation information and multiple procurement methods being utilized?

Analyzing zero-borrowing of our library's purchased resources helps uncover data's potential value and continuously optimize resource development service strategies.

Note: Low zero-borrowing rates are marked blue, high zero-borrowing rates red, and moderate rates blue. "2019" indicates zero-borrowing of new books acquired in 2019 to date.

The data shows that political/legal, economic, cultural/scientific, agricultural science, environmental science, and general books have high zero-borrowing rates for five consecutive years. Astronomy/geography and transportation have high zero-borrowing rates for four consecutive years. Literature, aerospace, biological science, medical/health, and mathematical/physical sciences have high borrowing rates for five consecutive years. Marxism-Leninism, arts, and general natural sciences have high borrowing rates for four consecutive years.

Marxism-Leninism: Consistently low acquisition, low zero-borrowing, high utilization (similar: general natural sciences, aerospace, biological science, medical/health). Recommendation: Increase procurement.

Environmental Science: Consistently low acquisition, high zero-borrowing, low utilization (similar: general books, agricultural science). Recommendation: Reduce procurement except for resource security.

Literature: High acquisition, low zero-borrowing, high utilization (similar: mathematical/physical sciences, industrial technology). Recommendation: Increase procurement.

Political/Legal: High acquisition, high zero-borrowing, low utilization (similar: economics, science/education). Recommendation: Reduce procurement.

Due to the pandemic, print book borrowing declined significantly from 2020–2022. Therefore, optimizing recommendation service processes, collection struc-

ture, professional literature supplementation, and copy number adjustments requires more communication with resource development colleagues. The data analysis here serves as a reference.

1.1.4 Relationship Between Four-Year Undergraduate Borrowing Volume and Weighted Average GPA

As future learning centers, whether smart libraries can improve borrowing rates to help students enhance academic performance has long been a key concern. By analyzing borrowing volume and academic performance data for students in specific colleges during their study period, we can determine the relationship between book borrowing and undergraduate weighted average GPA. The results will provide valuable references for future smart library construction.

Using the Naval Architecture College as an example: Three undergraduate cohorts were selected (2017 cohort graduating 2021, 2018 cohort graduating 2022, 2019 cohort graduating 2023). The top 10 students by total books borrowed were selected from each cohort, totaling 30 students.

Top 10 Borrowers by Cohort

Cohort	Student ID	Name	College	Major
2017	-	Su Haochen	Naval Architecture	Naval Architecture & Ocean Engineering
2017	-	Wang Yuhan	Naval Architecture	Naval Architecture & Ocean Engineering
2017	-	Wang Chen	Naval Architecture	-
2017	-	Wang Shouhang	Naval Architecture	Naval Architecture & Ocean Engineering
2017	-	Han Yiming	Naval Architecture	Naval Architecture & Ocean Engineering
2017	-	Huo Wei	Naval Architecture	-

Cohort	Student ID	Name	College	Major
2017	-	Liu Mingliang	Naval Architecture	Naval Architecture & Ocean Engineering
2017	-	He Kangjian	Naval Architecture	Naval Architecture & Ocean Engineering
2017	-	Li Yongjin	Naval Architecture	Port, Waterway & Coastal Engineering
2017	-	Xiao Wangsui	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Huang Guoqing	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Dai Xinbo	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Xu Qingfeng	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Li Ao	Naval Architecture	Naval Architecture & Ocean Engineering

Cohort	Student ID	Name	College	Major
2018	-	Yu Wei	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Wang Sibin	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Qiu Yuncong	Naval Architecture	Port, Waterway & Coastal Engineering
2018	-	Liu Shijie	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Yang Jingqi	Naval Architecture	Naval Architecture & Ocean Engineering
2018	-	Deng Yufei	Naval Architecture	Naval Architecture & Ocean Engineering
2019	-	Yang Chaoyue	Naval Architecture	Port, Waterway & Coastal Engineering
2019	-	Chen Yan	Naval Architecture	Naval Architecture & Ocean Engineering

Cohort	Student ID	Name	College	Major
2019	-	Wang Zihe	Naval Architecture	Port, Waterway & Coastal Engineering
2019	-	Shi Xufang	Naval Architecture	Naval Architecture & Ocean Engineering
2019	-	Sun Linhua	Naval Architecture	-
2019	-	Ren Chengyi	Naval Architecture	-
2019	-	Chu Guangyao	Naval Architecture	Naval Architecture & Ocean Engineering
2019	-	Tang Haotian	Naval Architecture	-
2019	-	Wang Xinglai	Naval Architecture	Naval Architecture & Ocean Engineering
2019	-	Wang Yifei	Naval Architecture	Naval Architecture & Ocean Engineering

Analysis of 2017 Cohort (Statistics Period: 2017.9.1–2021.7.1)

The top 10 borrowers included students from three majors:

(1) **Port, Waterway & Coastal Engineering** (55 students, weighted GPA median: 80.91): 1 student entered the top 10 (Li Yongjin), with weighted GPA 82.71, ranking 21st academically, borrowing 200 books (9th in borrowing).

(2) **Naval Architecture Class** (25 students, weighted GPA median: 79.08): 2 students entered the top 10 (Wang Chen: GPA 91.29, rank 1, 237 books, rank 3; Huo Wei: GPA 88.94, rank 3, 217 books, rank 5). Both met postgraduate recommendation requirements.

(3) **Naval Architecture & Ocean Engineering** (216 students, weighted GPA median: 81.61): 7 students entered the top 10. Approximately 3 met postgraduate recommendation requirements (estimated based on 25-30% recommendation rate). All top 10 borrowers had GPAs above the median. Post-graduation destinations: 7 pursued graduate studies at HEU, Shanghai Jiao Tong University, or China Ship Scientific Research Center; 3 entered employment.

Analysis of 2018 Cohort (Statistics Period: 2018.9.1–2022.7.1)

The top 10 borrowers included students from two majors:

(1) **Port, Waterway & Coastal Engineering** (40 students, weighted GPA median: 80.58): 1 student entered the top 10 (Qiu Yuncong), GPA 80.84, rank 20, 193 books, rank 7.

(2) **Naval Architecture & Ocean Engineering** (254 students, weighted GPA median: 81.29): 9 students entered the top 10. Three met postgraduate recommendation requirements. Seven had GPAs above the median; three below. Four had failed courses. Post-graduation destinations: 8 pursued graduate studies at HEU, Shanghai Jiao Tong University, Dalian University of Technology, or Xi'an Jiaotong University; 2 entered employment.

Analysis of 2019 Cohort (Statistics Period: 2019.9.1–2023.6.27)

The top 10 borrowers included students from four majors:

(1) **Port, Waterway & Coastal Engineering** (37 students, weighted GPA median: 75.80): 2 students entered the top 10.

(2) **Naval Architecture Class** (22 students, weighted GPA median: 83.22): 1 student entered the top 10.

(3) **Naval Architecture & Ocean Engineering** (219 students, weighted GPA median: 78.49): 5 students entered the top 10.

(4) **Robotics** (60 students, weighted GPA median: 84.80): 2 students entered the top 10.

Approximately 4 students met postgraduate recommendation requirements (40% of top 10). Six had GPAs above the median; four below. Three had failed courses. Post-graduation destinations: 8 pursued graduate studies at HEU (Qingdao Innovation Base), Harbin Institute of Technology, etc.; 1 was held back; 1 completed studies without degree.

Conclusion: Among 30 top borrowers from 2017–2019 cohorts, 40% met postgraduate recommendation requirements, 30% had failed courses, 76.7% had GPAs above the median, and 23.3% below. For 2021–2023 graduates, 23 (76.7%) continued studies (higher than HEU's average: 53.33% in 2021, 56.98% in 2022), 5 (16.7%) entered employment, and 2 (6.7%) did not graduate.

This analysis demonstrates a positive correlation between borrowing volume and academic performance. Attracting students to borrow books can improve academic achievement, strengthen knowledge foundations, and support future studies, research, and employment. The following section analyzes student library visits through access control data.

1.2 Relationship Between Student Library Visits and Borrowing Volume

Since print books can only be borrowed in-person, increasing circulation requires increasing visits. Statistics show annual average non-visit rates: undergraduates 8.5%, master's students 29%, doctoral students 39%. Undergraduate non-visit rates roughly equal non-borrowing rates, while master's and doctoral non-visit rates slightly exceed non-borrowing rates, suggesting most students borrow when they visit. Attracting more students to the library can improve print resource utilization, making library attractiveness a key factor.

Note: Statistics cover 2020, 2021, 2022, and 2023 (2023 data: 2023.01.01–2023.07.12).

Key factors affecting library attractiveness include rich collections and efficient borrowing processes. Rich collections satisfy student learning and knowledge creation needs. In superior library environments with spacious study areas and smart space services, student learning efficiency improves significantly, enhancing library affinity and dependence. Architecture and supporting facilities are also critical—iconic buildings and comprehensive facilities enhance library attractiveness.

Other effective methods from peer libraries are worth emulating. For example, a Guangxi university library provides orientation for freshmen, including not only lectures and tours but also group borrowing experiences with teacher guidance. This can zero out zero-borrowing students during degree programs and cultivate borrowing habits, substantially increasing print circulation. Various reading activities combined with the Student Affairs Office's "Second Classroom Transcript" system award credits for participation, boosting enthusiasm. The "One Hour Power-Off" activity involves organizing students to borrow books, power off phones for one hour of focused reading, then sharing reflections. Such activities significantly increase print book borrowing.

Chapter 2: Smart Space Services

Smart space services involve library space reengineering to provide diversified spatial services using IoT, AI, and new media technologies to meet personalized, diversified reading and learning needs. Research shows learning and discussion spaces are the main form of smart space services, with 46.15% of university libraries offering them—either by upgrading traditional spaces with AI and new equipment or building new spaces. Other smart spaces include audio-visual spaces (15.38%), digital technology experience spaces (10.26%), and multimedia

learning spaces, maker spaces, recording/photography spaces, digital academic spaces, and information commons (each <10%).

2.1 Utilization of Smart Space Seminar Rooms

Our library's learning and discussion spaces are well-equipped with projectors, whiteboards, and other new media devices for seminars, self-study, video conferences, and research activities.

2.1.1 2022 Seminar Room Usage Analysis

No.	Name	Total Usage Time	Users	Visits
C507	Small Seminar Room (5F)	1538h 37m	-	-
C504	Small Seminar Room (5F)	1467h 32m	-	-
C502	Small Seminar Room (5F)	1454h 22m	-	-
C503	Small Seminar Room (5F)	1356h 41m	-	-
C511	Small Seminar Room (5F)	1298h 31m	-	-
C506	Small Seminar Room (5F)	1230h 26m	-	-
C508	Small Seminar Room (5F)	1220h 32m	-	-
C505	Small Seminar Room (5F)	1191h 39m	-	-
C510	Small Seminar Room (5F)	1136h 31m	-	-
C514	Small Seminar Room (5F)	1134h 23m	-	-
C516	Small Seminar Room (5F)	1132h 9m	-	-
C519	Small Seminar Room (5F)	1128h 57m	-	-
C521	Small Seminar Room (5F)	1123h 37m	-	-
C512	Small Seminar Room (5F)	1073h 44m	-	-
C520	Small Seminar Room (5F)	1063h 44m	-	-
C515	Small Seminar Room (5F)	1025h 54m	-	-
C513	Small Seminar Room (5F)	1001h 37m	-	-
C509	Small Seminar Room (5F)	964h 47m	-	-
C517	Small Seminar Room (5F)	910h 9m	-	-
C518	Small Seminar Room (5F)	901h 47m	-	-
C501	Large Seminar Room (5F)	440h 39m	-	-
C522	Large Seminar Room (5F)	182h 44m	-	-

Statistics period: 2022.1.1–2022.6.31. Small seminar rooms are very popular, with usage times of 900–1500 hours.

2.1.2 2022 Small Seminar Room Usage by College Nuclear Science, Underwater Acoustics, Materials/Chemistry, Intelligent Science/Engineering, and Naval Architecture ranked 1st–5th in usage.

While seminar rooms are fully booked, bright window-side or quiet area seats are also in high demand, creating serious seat-hogging problems. How can

we objectively and simply reveal overall space utilization? This is a practical problem requiring solution.

2.2 Library Space Utilization Rate

2.2.1 Space Utilization Data Analysis Metrics Data from access control systems for April, May, June and September, October, November 2022 show that 85% of visitors stayed >0.5 hours in spring, while 89%–91% stayed >0.5 hours in fall. This indicates fall semester visitors prioritize space utilization more (e.g., for postgraduate entrance exams, certification tests). Space utilization can be calculated as real-time in-library population divided by total reading and study seats.

2.2.2 Seat Classification and Space Utilization

Seat Type	Quantity	Subtotal
Reading Room Seats	-	962
Common Book Area	-	-
Science Book Area	-	-
E-reading Seats	-	-
Social Science Book Area	-	-
E-reading Room	-	-
Study Room Seats	-	4228
Common Book Area	-	-
Science Book Area	-	-
Social Science Book Area	-	-
3F Ring Study Area	-	-
4F Ring Study Area	-	-
5F Ring Study Area	-	-
5F C Area Study Area	-	-
6F Ring Study Area	-	-
B619 Study Room	-	-
B620 Study Room	-	-
A301 Study Room	-	-
A302 Study Room	-	-
A303 Study Room	-	-
B301 Study Area	-	-
B303 Study Area	-	-
A403 Study Room	-	-
A404 Study Room	-	-
A405 Study Room	-	-
A501 Study Room	-	-
A502 Study Room	-	-
A503 Study Room	-	-
B505 Study Area	-	-

Seat Type	Quantity	Subtotal
B507 Study Area	-	-
B621 Study Area	-	-
7 Audio Booths	-	-
4 Interview Booths	-	-
Other Space Seats	-	425
Total Seats	-	**5615**

The library has 4,228 study room seats, 962 reading room seats, and 425 other space seats. Daily open areas include study and reading room seats, so utilization can be calculated as real-time visitors divided by the sum of these two categories.

Space utilization analysis is a major innovation in smart space services, achieving three goals: (1) Real-time graphical display of space utilization to reduce seat-hogging; (2) Demonstration of space construction level and achievements; (3) Reference for future space construction decisions.

2.2.3 Implementation Environment and Development Technology
Anolis OS 8.8 (Dragon Lizard) is deployed on Docker as a background daemon. Frontend uses Flask + ECharts + HTML/CSS/JS: pie charts display current occupancy, line charts show utilization trends throughout the day [Figure 1: see original paper], refreshing every minute. The frontend uses dynamic pages with a tech-savvy template similar to existing real-time displays. Backend network configuration uses bridge mode in intranet environment. Flask calls the database via Python code. Database uses abstract SQLAlchemy or MySQL. The page provides IP + port access. Database API provides current visitor numbers. Utilization = current visitors / total seats. Data is stored hourly from 7am–10pm (14 entries daily).

Access Control Server Interface
Address: 172.16.1.16
Port: 1433
Type: SQL Server
Database: skedb2020
Username: skevisit
Password: ske****2017
View: todayinoutnum
Field: inlibrary

The display shows: (Upper left) Current occupancy pie chart (in-library vs. available seats); (Lower left) Bar chart of visitors by college; (Right) Real-time space utilization curve from 8:00–22:00. Development is being assisted by computer science students and progressing smoothly.

Chapter 3: WeChat Official Account Reader Behavior Analysis

As traditional services integrate with big data, intelligent robots, IoT, and 5G, and library infrastructure strengthens, mobile library apps and WeChat have become mainstream mobile service methods. The WeChat Official Account Platform, built on WeChat's massive user base, can publish various messages with personalized, diversified, and efficient characteristics. In recent years, university libraries have actively registered WeChat accounts, leveraging fast dissemination and low promotion costs to improve service quality and effectiveness.

3.1 Top 20 Words in Most-Read Articles from 42 Science and Engineering University Libraries

Analysis of 800 articles with >1,000 clicks from prominent science/engineering university libraries (Hunan University, Wuhan University, Dalian University of Technology, Shanghai Jiao Tong University, Zhejiang University, etc.) in the first half of 2023 reveals popular vocabulary, showing student reading preferences and interests.

3.2 Word Cloud of Top 100 Words in Most-Read Articles

A word cloud of the top 100 words visually shows that "open," "announcement," "reading," "bookish culture," "lecture," "activity," "annual," "book," and "service" are of high interest to science/engineering students.

"Open" and "announcement" correspond to notification-type articles. "Reading" corresponds to articles like reading contests, annual reading reports, and reading festivals. "Service" corresponds to articles about thesis plagiarism checking, facility updates, seat reservation surveys, volunteer recruitment, and equipment lending. "Activity" corresponds to articles about book fairs, blind box events, reading culture festivals, and various campus activities.

Each vocabulary term can be deeply explored. Every activity and service can integrate smart library technologies, using student-interest events as starting points to increase visits and achieve full resource utilization. (Due to data acquisition complexity and time constraints, this research will be continued later.)

Chapter 4: Conclusion

This report analyzes the current state of smart library services in borrowing, resource development, personalized services, and spatial services based on our library's reader behavior data, exploring methods, content, and forms for smart services and offering recommendations for creating a favorable smart library environment.

Rich collections and efficient borrowing processes are key factors affecting library attractiveness. Rich collections satisfy student learning and knowledge creation needs. In superior library environments with spacious study areas and smart space services, student learning efficiency improves significantly, enhancing library affinity and dependence.

First, to attract students to borrow books, we analyzed preferred book types by college and discipline to targetedly increase popular categories. To better meet learning needs and support teaching/research, we should use circulation data, strengthen communication with academic affairs and departments, understand curriculum plans, track faculty/student numbers, monitor disciplinary developments, and targetedly meet borrowing needs. Analyzing zero-borrowing of purchased resources uncovers data value and optimizes resource development strategies.

Second, space utilization analysis is a major innovation in smart space services, achieving three goals: real-time graphical display to reduce seat-hogging, demonstration of space construction achievements, and reference for future construction decisions.

Third, analyzing popular vocabulary in >1,000-click articles from prominent science/engineering university libraries reveals student reading preferences. Each term can be deeply explored, with smart library technologies integrated into activities and services to increase visits and achieve full resource utilization.

This analysis inspires new service models. Starting from visit frequency, we found high correlation between visits and service provision. Using smart library technologies to attract students is the basic service model. Only by grasping this key factor can we improve literature and space resource utilization, laying a foundation for smart services. We can increase attractiveness through: (1) Targeted personalized professional books for different readers; (2) Continuously improving space practicality, furniture flexibility, and decorative artistry; (3) Learning from successful peer experiences. These service model innovations are based on big data analysis, offering strong practicality and daily operability.

Note: Figure translations are in progress. See original paper for figures.