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Analysis of Reader Behavior Diversity and Exploration of Precision Service Model in University Libraries —A Case Study of Xihua University Library

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Abstract

With the rapid development of information technology and digital resources, mining reader behavior characteristics and constructing a precision service model have become critical paths for university libraries to improve service quality and resource utilization efficiency. Taking the access control and borrowing data of Xihua University Library as samples, this paper conducts a systematic analysis from two dimensions of group distribution and individual behavior, covering campus affiliation, college, reader identity, entry time slot, visit frequency and stay duration after data cleaning and standardization, so as to reveal the diversity of reader behavior patterns. Meanwhile, adopting the extreme value normalization method and weighted summation method, three core indicators (library visit frequency, total stay duration and average single-visit duration) are selected to construct a student library activity portrait model. The study finds that readers' library entry behavior in university libraries generally presents a temporal pattern of "double hump + evening peak", and the two-stage study mode with midday return is the mainstream usage pattern; significant differentiation exists in visit frequency, duration and time slot preference among different groups. The research results can provide data support for university libraries to optimize operation and maintenance scheduling, design tiered spatial services and push targeted resources, and have reference significance for promoting the construction of a personalized precision service system in libraries.

Keywords

University libraries, Reader behavior, Diversity analysis, Precision service model

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1. Introduction

1.1 Research Background

With the rapid development of information technology, the service mode of university libraries and the analysis of reader behavior are also facing unprecedented challenges and opportunities. Against the background of the digitalization of book resources, university libraries are confronted with new topics such as digital resource utilization and information literacy education. Therefore, in-depth research on the characteristics of reader behavior in university libraries and exploration of precision service models are important approaches to improve library service quality and reader satisfaction ^[1].

At present, most domestic and foreign studies on reader behavior in university libraries focus on reader satisfaction and usage preference, while there are few systematic studies on the diversity of reader behavior and precision service models. Supported by big data technology, how to use data mining and other means to analyze the diversity of reader behavior and build a service model that meets the needs of different readers is an urgent problem to be solved at present ^[2].

This paper mainly collects and analyzes the reader behavior data of university libraries, identifies the diversity characteristics of reader behavior, and explores a precision service model based on these characteristics. By constructing a student portrait model and taking Xihua University as an application case, this paper aims to provide scientific and effective reader service strategies for university libraries, improve library resource utilization, and promote the personalized development of reader services.

1.2 Literature Review

University libraries are an organic part of higher education, and research on their service models and reader behavior has long attracted academic attention. In recent years, with the development of information technology and the application of big data, the analysis of reader behavior diversity and the exploration of precision service models in university libraries have become a new research trend ^[3].

At present, questionnaire survey is a common research method for university readers. For example, Ma Xiaobo from Nanjing University of Aeronautics and Astronautics used a questionnaire to summarize and analyze students' use of the library learning commons ^[4]; Wu Rongxia from Liaocheng University analyzed readers' needs through a random questionnaire survey and proposed countermeasures to improve literature service level ^[5].

In recent years, with the continuous upgrading of data analysis technology, more and more studies have begun to attach importance to the collection and processing of reader behavior data. For instance, Liu Jing from Qingdao University of Science and Technology systematically sorted out four dimensions of reader behavior data based on the big data technology framework, built a full-process analysis system covering collection, preprocessing, modeling and visualization, conducted in-depth mining through an improved K-means clustering algorithm and behavior weight model, and presented readers' borrowing preferences, spatial utilization rules and demand evolution trends with visualization technology ^[6].

To sum up, although existing studies have enriched the theoretical and practical foundations of research on reader behavior diversity and precision service models in university libraries to a certain extent, there

are still problems such as single data source and outdated analysis methods. Future research should expand data source channels and innovate analysis methods, so as to promote the comprehensive improvement of university library service quality.

2. Analysis of Reader Behavior Diversity in University Libraries

2.1 Data Source and Processing of Reader Behavior

Before analyzing the diversity of reader behavior in university libraries, it is necessary to collect and process relevant data first. The data mainly come from library management systems, questionnaire surveys, online feedback systems and social media platforms, which can provide information on readers' library visit frequency, borrowing preferences, usage time slots and other aspects.

The data processing process is divided into three core parts: data cleaning, data integration and data transformation. Data cleaning refers to removing invalid or erroneous data records to ensure data quality. Data integration refers to merging data from different sources into a unified dataset for subsequent analysis. Data transformation refers to converting raw data into an analyzable format, for example, converting text information into numerical data. This paper takes the annual access records of Xihua University Library in a certain year as samples, as shown in Table 1.

Note: The access control data and quantitative indicators related to library entry and borrowing used in this paper belong to the school's study style assessment ledger, involving student group privacy. In accordance with the school's data security management regulations, they are desensitized as "N/A"; omitted parts are uniformly marked with long dashes "—", and the overall analysis conclusions are not affected by the hidden data.

Table 1. Annual Library Usage Data of Xihua University

Campus	Reader Name	Student ID	Reader Identity	College/Department	Major	Grade	Class	Dormitory	Number of Visits	Stay Duration
Pidu	N/A	N/A	Undergraduate	School of Management	Business Administration	2024	N/A	N/A	N/A	N/A
Pidu	N/A	N/A	Undergraduate	School of Mechanical Engineering	Mechanical and Electronic Engineering	2023	N/A	N/A	N/A	N/A
Pidu	N/A	N/A	Undergraduate	School of Economics	Financial Technology	2023	N/A	N/A	N/A	N/A
Pidu	N/A	N/A	Undergraduate	School of Literature, Journalism and Communication	Network and New Media	2023	N/A	N/A	N/A	N/A
Yibin	N/A	N/A	Undergraduate	School of Materials	Welding	2024	N/A	N/A	N/A	N/A

				Science and Engineering Technology and Engineering						
				School of Transportation						
Yibin	N/A	N/A	Undergraduate	and Automotive Transportation Engineering	2025	N/A	N/A	N/A	N/A	
Yibin	N/A	N/A	Undergraduate	School of Foreign Languages Translation	2023	N/A	N/A	N/A	N/A	
Yibin	N/A	N/A	Undergraduate	School of Architecture Engineering and Civil Engineering Management	2024	N/A	N/A	N/A	N/A	
Other samples	N/A	N/A	—	—	—	N/A	N/A	N/A	N/A	

To better clean the raw data, it is necessary to write codes to automate the data processing. The following is a simple Python code example: first set the official school data as Mapping Data.xlsx, then map the "Student ID" in Mapping Data.xlsx with Raw Data.csv to correct the fields in Raw Data.csv including campus, reader name, student ID, reader identity, college/department, major, grade, class and dormitory name, and finally output the result to Corrected Data.xlsx. Through the above steps, the reader behavior data of university libraries can be effectively obtained and processed, laying a foundation for subsequent analysis and research.

2.2 Overall School Data Analysis

In the analysis of reader behavior diversity in university libraries, library entry data is a fundamental and important part. Through detailed classification of entry data, the library visit frequency and preference of readers in different campuses, colleges, grades, classes and majors can be identified, providing data support for subsequent behavior characteristic analysis.

Library entry data mainly includes the number of visitors, number of visits, in-library stay duration, number of borrowers and number of borrowed volumes. The annual data from the previous section can be briefly summarized as shown in Table 2.

Table 2. Summary of Annual Library Usage Data of Xihua University

Data Type	Volume	Data Source
Number of unique visitors	N/A	Library access control management system
Total number of visits	N/A	Library access control management system
Total in-library stay duration	N/A	Library access control management system
Number of borrowers	N/A	Library Huiwen management system
Total borrowed volumes	N/A	Library Huiwen management system

To further analyze the library entry situation of each college, we can further split the raw data, add proportion data and per capita data, compare with the data of the same period last year, and record the increase or decrease, as shown in Table 3, Table 4 and Table 5.

Table 3. Summary of Library Entry by Grade of Each College, Xihua University Library

College	Campus	Grade	Proportion of Visitors (%)	YoY Change	Per Capita Visits	YoY Change	Per Capita Stay Duration	YoY Change	Proportion of Borrowers (%)	YoY Change	Per Capita Borrowed Volumes	YoY Change
School of Management	Pidu	2022	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Management	Pidu	2023	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Management	Pidu	2024	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Foreign Languages	Yibin	2022	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Foreign Languages	Yibin	2023	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Foreign Languages	Yibin	2024	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
Other colleges	—	—	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—

Table 4. Summary of Library Entry by Major of Each College, Xihua University Library

College	Campus	Major	Proportion of Visitors	YoY Change	Per Capita Visits	YoY Change	Per Capita Stay Duration	YoY Change	Proportion of Borrowers	YoY Change	Per Capita Borrowed Volumes	YoY Change
School of Science	Pidu	Mathematics and Applied Mathematics	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Management	Pidu	Business Administration	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of	Pidu	Mechanical	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—

Mechanical Engineering School of Computer and Software Engineering	Yibin	and Electronic Engineering Intelligence Science and Technology	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
Foreign Languages School of Economics	Yibin	Transportation International Economics and Trade	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
Other colleges	—	—	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—

Table 5. Summary of Library Entry by Class of Each College, Xihua University Library

College	Campus	Class	Proportion of Visitors	YoY Change	Per Capita Visits	YoY Change	Per Capita Stay	YoY Change	Proportion of Borrowers	YoY Change	Per Capita Borrowed Volumes	YoY Change
School of Science	Pidu	Chemistry25-5	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Management	Pidu	Logistics Management 22-1	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Mechanical Engineering	Pidu	Mechanical Design, Manufacturing and Their Automation 22-5	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Computer and Software Engineering	Yibin	Intelligence Science and Technology 23-2	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—

School of Foreign Languages	of Yibin	Transportation 24-1	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
School of Economics	of Yibin	International Economics and Trade 22-3	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—
Other colleges	—	—	N/A	—	N/A	—	N/A	—	N/A	—	N/A	—

The above tables show the proportion and average value of library entry and borrowing of each college from the three dimensions of grade, major and class. This structure enables each college to quickly locate its core data and compare the differences between the current year/quarter/month and the same period of the previous year. The above data processing methods can help schools, colleges and functional departments form a preliminary understanding of the overall library usage, and provide scientific support for the construction of precision service models in university libraries [7].

2.3 Analysis of Reader Library Entry Behavior Characteristics

In this section, we further analyze the characteristics and preferences of individual readers' library entry behavior. Taking the full-day access data of the Pidun Campus Library of Xihua University on a certain day as an example, we use data mining methods to analyze readers' entry and stay behavior on that day. The raw data includes campus, reader name, student ID, reader identity, college/department, entry time, exit time and stay duration, as shown in Table 6.

Table 6. Access Control Data of Xihua University Library (YYYY-MM-DD)

Campus	Reader Name	Reader ID	Reader Identity	College/Department	Entry Time	Exit Time	Stay Duration (h)
Pidu	N/A	N/A	Student	N/A	8:49	10:42	1.88
Pidu	N/A	N/A	Student	N/A	10:42	11:19	0.61
Pidu	N/A	N/A	Student	N/A	11:41	13:19	1.62
Pidu	N/A	N/A	—	—	—	—	—

Next, we analyze the data from 5 dimensions:

(1) Analyze the library entry preference of readers with different identities. Define: Number of readers of identity g : $S_g = \text{CountUnique}(\text{Reader ID}, \text{Identity} = g)$; Total number of visits of identity g : $N_g = \sum_{i=1}^{N_{all}} I(\text{Identity}_i = g)$; Per capita visits of identity g : $\bar{V}_g = \frac{N_g}{S_g}$; Average single-visit stay duration of

identity g : $\bar{T}_g = \frac{1}{N_g} \sum_{i \in g} t_i^{\text{stay}}$; Per capita total daily stay duration of identity g : $\overline{T_g^{\text{day}}} = \bar{V}_g \times \bar{T}_g = \frac{1}{s_g} \sum_{i \in g} t_i^{\text{stay}}$. The calculation results show that in this month, junior college students in the Pidun campus have higher library entry frequency and longer stay duration than undergraduates and postgraduates; postgraduates have the shortest per capita daily stay, presenting a "short and frequent" consultation-oriented usage pattern, as shown in Table 7.

Table 7. Library Entry Behavior Preference of Readers with Different Identities

Identity	Total Visits	Per Capita Visits	Average Single-Visit Duration	Per Capita Total Daily Duration
Undergraduate	N/A	N/A	N/A	N/A
Postgraduate	N/A	N/A	N/A	N/A

(2) Analyze the time slot distribution of library entry for readers with different identities. The day is divided into three time slots: 7:30-12:00, 12:00-18:00 and 18:00-22:30. The calculation formula is:

$P_{g,\text{slot}} = \frac{M_{g,\text{slot}}}{N_g} \times 100\%$, where $M_{g,\text{slot}}$ is the number of entry records of readers with identity g in the corresponding time slot. The results show that postgraduates account for the highest proportion of library entry during 7:30-12:00, with the strongest willingness to study in the morning, as shown in Table 8.

Table 8. Time Slot Preference of Library Entry for Readers with Different Identities

Identity	Morning (7:30-12:00)	Afternoon (12:00-18:00)	Evening (18:00-22:30)	Dominant Time Slot
Postgraduate	N/A	N/A	N/A	Morning-dominant, comparable in afternoon
Undergraduate	N/A	N/A	N/A	Absolute dominance in afternoon

(3) Analyze the distribution of readers' daily library entry frequency. The calculation formula is: $R_k = \frac{C_k}{S_{\text{all}}} \times 100\%$, where C_k is the number of students who enter the library exactly k times a day. The results show that more than 70% of readers enter the library 1-2 times a day, conforming to the typical two-stage study pattern of "arrive in the morning, leave at noon; return in the afternoon, leave in the evening", as shown in Table 9.

Table 9. Distribution of Daily Library Entry Frequency

Number of Daily Visits	Number of Students	Proportion	Typical Behavior Characteristics
1	N/A	N/A	Single long-duration study per day
2	N/A	N/A	Leave for lunch at noon, two round trips a day
3	N/A	N/A	Three-stage entry and exit (morning, noon, evening)
4	N/A	N/A	High-frequency entry and exit, fragmented usage
5	N/A	N/A	Extremely high-frequency round trips
6 and above	N/A	N/A	Multiple entries and exits throughout the day (max 8 times)

(4) Analyze readers' single-visit stay duration to summarize behavior preferences. The calculation formula is: $Q_h = \frac{L_h}{N_{all}} \times 100\%$, where L_h is the number of entry records falling into duration interval h .

The results show that more than half of the readers stay for 1-4 hours, and 2-3 hours is the most mainstream duration; "check-in" visits shorter than 1 hour account for less than 20%, as shown in Table 10.

Table 10. Preference of Single-Visit Stay Duration

Stay Duration Interval	Number of Visitors	Proportion	Behavior Interpretation
< 0.5 h	N/A	N/A	Quick borrowing / looking for someone / passing by
0.5-1 h	N/A	N/A	Short consultation
1-2 h	N/A	N/A	Short-duration study
2-3 h	N/A	N/A	Standard study unit (highest proportion)
3-4 h	N/A	N/A	Long-duration in-depth study
> 4 h	N/A	N/A	Half-day immersive stay

(5) Analyze the peak distribution of entry visits at different time points. The calculation formula is: $V_{t_h} = \text{Count}(\text{Entry Hour} = t_h)$. The results show that the daily flow presents a "double hump + evening peak" pattern: a small peak at 8:00-10:00 in the morning, a large peak at 12:00-15:00 in the afternoon, and the highest peak of the day at 18:00; the flow drops rapidly after 21:00, and entry almost stops at 22:00, as shown in Table 11.

Table 11. Peak Distribution of Entry Visits by Time Point

Time Point	Number of Entry Visits	Peak Rank	Typical Behavior Characteristics
18:00	N/A	1	Highest peak for study after dinner
14:00	N/A	2	Peak after afternoon classes / after lunch break
13:00	N/A	3	Return to library after lunch
12:00	N/A	4	Concentrated entry after morning classes
09:00	N/A	5	Entry before morning classes
08:00	N/A	6	Entry for morning self-study / morning reading
15:00	N/A	—	Secondary afternoon peak
19:00	N/A	—	Secondary evening peak

To sum up, we can provide a basis for formulating more precise library service strategies according to the diversity of readers' behavior preferences [8]. For example: optimize security, cleaning and operation scheduling according to flow peaks and valleys to reduce manpower waste; design tiered study areas and supporting facilities according to entry duration and frequency characteristics to match different learning needs; arrange training at off-peak times and push targeted resources according to the time preference of different educational groups to improve attendance and matching degree.

3. Exploration of Precision Service Model Based on Student Portrait

3.1 Construction of Student Portrait Model

The construction of student portraits relies on big data analysis and machine learning technology, aiming to collect and analyze students' various behavior data and build a comprehensive and dynamic student information model. The model includes students' basic information (age, gender, major, etc.) as well as their library behavior data such as borrowing records, visit frequency and stay duration.

The first step of building student portraits is data collection: obtain students' borrowing history, access records and other data from the library management system. Then, data preprocessing methods are used to clean and organize the collected data to ensure data quality and consistency. After that, clustering algorithm is used to classify students' data and identify student groups with similar behavior characteristics.

In the process of building student portraits, we use the following formula for calculation: $S_i = \sum_{j=1}^n w_j \cdot x_{ij}$, where S_i represents the activity score of student i , x_{ij} is the performance value of student i on the j -th feature, and w_j is the weight of the j -th feature. The core of this formula is to weight and sum up multiple behavior characteristics of students to obtain a comprehensive score. The higher the score, the stronger the student's library activity.

Construction process:

(1) Taking the raw data in Table 8 as an example, extract 3 core behavior features: library entry frequency,

total stay duration and average single-visit duration; (2) Set feature weights w_j : entry frequency weight $w_1 = 0.3$, total stay duration weight $w_2 = 0.4$, average single-visit duration weight $w_3 = 0.3$; (3) Perform feature normalization to map all features to the interval $[0,1]$: $x'_ij = \frac{(x_{ij} - \min(x_j))}{(\max(x_j) - \min(x_j))}$, where $\min(x_j)$ and $\max(x_j)$ are the minimum and maximum values of all students on the j -th feature respectively; (4) Substitute the normalized features into the weighted summation formula: $S_i = w_1 \cdot x'_{i1} + w_2 \cdot x'_{i2} + w_3 \cdot x'_{i3}$, The score ranges from 0 to 1. A higher score indicates higher library activity of the student on that day. Through the above steps, a relatively complete student portrait model can be obtained, so as to provide accurate service strategies for university libraries.

4. Conclusion

Through the analysis of reader behavior diversity in university libraries, this paper identifies the differences in library resource utilization among various groups, and provides theoretical basis and practical guidance for the exploration of library precision service models. This paper constructs a student portrait model and conducts an applied case study with Xihua University as an example, using big data technology to tap readers' needs and achieve personalized services. The implementation of the precision service model requires library managers to have strong data analysis ability and innovative spirit to meet the diverse needs of readers [9].

In the future, more data processing methods such as sentiment analysis and social network analysis can be adopted to form a more comprehensive understanding of reader behavior. In addition, with the continuous development of artificial intelligence technology, how to apply artificial intelligence to library services to provide readers with more intelligent and personalized services will also be the focus of future research [10].

Therefore, this paper provides empirical evidence for the precision service model of university libraries, and also provides new research perspectives and ideas for researchers in related fields. It is expected that more scholars will join this field in the future to jointly promote the innovative development of library service models, better meet readers' needs, and promote the dissemination and sharing of knowledge [11].

References

- [1] Liu Jun. (2022). Analysis of Precision Services in Higher Vocational College Libraries Based on Reader Behavior. *Cultural Industries*, 2022(09), 107-109.
- [2] Zhuang Huihui, Qin Xianjing, & Yang Ziyang. (2023). Exploration of Library Precision Services Oriented to Reader Needs. *Communication and Copyright*, 2023(16), 71-73+77. <https://doi.org/10.16852/j.cnki.45-1390/g2.2023.16.011>
- [3] He Xiaoyan, & Wang Xiaoting. (2023). Exploration of Precision Service Model in University Libraries Based on Reader Demand. *Inner Mongolia Science Technology & Economy*, 2023(21), 154-157.

- [4] Ma Xiaobo, Zou Xiaozhu, & Zhao Jinzhi. (2015). Investigation on User Demand of Learning Commons in Nanjing University of Aeronautics and Astronautics Library. *Information Research*, 2015(6), 109-114.
- [5] Wu Rongxia, & Geng Qingjun. (2012). Investigation and Countermeasure Analysis of Readers' Demand for Literature Resources in University Libraries. *Science & Technology Information*, 2012(34), 466-467.
- [6] Liu Jing. (2026). Application of Big Data Technology in Reader Behavior Analysis of University Libraries. *China Management Informationization*, 29(11), 210-213.
- [7] Liu Fang, & Zhu Sha. (2020). Research on Precision Services of University Libraries Based on Reader Portraits. *Journal of Academic Library and Information Science*, 2020(01), 73-75.
- [8] Chen Zhihua. (2019). Analysis of Reader Service Mode in University Libraries Under the Background of Smart Library. *Wireless Internet Technology*, 2019(18), 87-88.
- [9] Zhang Xin. (2022). Research on Library Precision Services Based on Data Analysis of Reader Demand Behavior. *Library Work in Colleges and Universities*, 2022(04), 81-84+94.
- [10] Liu Na, & Kang Meijuan. (2021). Research on Reader Service Mode of University Libraries Based on Smart Library. *Office Operations*, 2021(11), 174-175.
- [11] Xu Huifang. (2021). Thoughts on Promoting Precision Reader Services Through Innovation Mode in University Libraries. *Technology Wind*, 2021(06), 160-162. <https://doi.org/10.19392/j.cnki.1671-7341.202106075>