

Article

A Study on User Satisfaction with University Libraries from the Perspective of Environmental Psychology: A Case Study of Shenyang University of Technology

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Abstract: As a core space for academic research, knowledge acquisition, and self-directed learning, the environmental design and service quality of university libraries directly affect user experience and learning efficiency. Environmental psychology focuses on the interaction between humans and their environment, providing important theoretical support for analyzing the impact of library spatial environments on users' psychological perceptions, behavioral choices, and satisfaction. Taking the library of Shenyang University of Technology as the research object, this study collects data through a questionnaire survey and systematically explores faculty and students' current usage and satisfaction from dimensions including usage frequency, spatial environment (noise control, spatial layout, open space, seating configuration), physical environment (lighting, ventilation, temperature), supporting facilities, and user needs. The findings indicate that while the library's basic environment and services are generally recognized by users, there remains significant room for improvement in furniture comfort, reading space expansion, and sunlight glare control. Based on environmental psychology theories such as density perception, privacy protection, and sensory adaptation, combined with survey results, targeted micro-renovation strategies are proposed in terms of acoustic and light environment regulation, temperature and humidity optimization, spatial reconfiguration, furniture upgrading, and supporting service improvement. These strategies aim to enhance spatial adaptability and user satisfaction, providing a reference for the refined construction and operation of university libraries.

Keywords: environmental psychology; university library; user satisfaction; spatial renovation; micro-renovation

1. Research Background and Significance

1.1. Research Background

In the context of the connotative development of higher education, university libraries have transformed from traditional document storage and lending centers into composite smart spaces integrating learning, discussion, information retrieval, and academic exchange. As an important place for daily learning and research, the library's spatial environment, facility configuration, and service quality not only affect user experience but also directly impact learning efficiency, focus, and academic output. With the diversification and higher quality demands for learning spaces, the shortcomings of traditional libraries in spatial layout, environmental adjustments, and facility adaptation have become increasingly apparent. How to improve user satisfaction through scientific spatial optimization has thus become a key issue in university library construction and management.

Environmental psychology, as an interdisciplinary field studying human-environment interactions, holds the core view that "the environment influences psychological states through sensory stimulation, and psychological states further dominate behavioral choices and experience evaluation." Applying environmental

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psychology theory to library space research enables an in-depth analysis of users' psychological perceptions and behavioral patterns under the influence of environmental factors such as noise, lighting, temperature, spatial density, and privacy protection, providing a scientific basis for library spatial design, environmental improvements, and service upgrading [1]. At present, some domestic universities have begun to pay attention to the relationship between library environments and user satisfaction, but empirical research targeting specific institutions remains scarce, especially systematic renovation plans based on environmental psychology.

As a key provincial university in Liaoning Province, Shenyang University of Technology's library, as the university's document information center and academic support platform, undertakes the important mission of serving teaching and research for the entire university community. To fully understand the current usage status and user needs of the library and accurately identify shortcomings in environmental construction, this paper conducts targeted investigation and renovation design from the perspective of environmental psychology, with distinct practical orientation.

1.2. Research Significance

1.2.1. Theoretical Significance

This study integrates environmental psychology theory with user satisfaction surveys in university libraries, enhancing the application of environmental psychology within educational spaces [2]. It offers a novel theoretical perspective and research paradigm for library space studies. Through empirical analysis, the study uncovers the intrinsic relationships between physical environmental factors in libraries (such as acoustic and light conditions, temperature and humidity, and spatial layout) and users' psychological perceptions and satisfaction. This deepens the understanding of spatial usage patterns in university libraries and provides data support and methodological references for related research.

1.2.2. Practical Significance

(1) Accurately identify problems: Through the questionnaire survey, comprehensively analyze the current status of the library of Shenyang University of Technology in terms of usage frequency, environmental quality, facility configuration, and spatial layout. This helps clarify areas with high user satisfaction and aspects requiring urgent improvement, providing precise guidance for library optimization and upgrading [3].

(2) Optimize spatial experience: Based on environmental psychology principles and survey findings, propose feasible micro-renovation strategies to enhance the library's spatial adaptability and comfort [4]. This includes adjustments in aspects such as acoustics, lighting, temperature, humidity, spatial layout, and furniture facilities, catering to users' diverse learning needs.

(3) Improve service quality: Offer practical recommendations for the refined management and operation of university libraries, supporting their transition from a "resource-oriented" model to a "user-oriented" approach [1]. This enhances core service capabilities and academic support functions, providing robust backing for the university's teaching and research development.

2. Research Purpose and Content

2.1. Research Purpose

1. Fully understand the current usage status of the library by faculty and students of Shenyang University of Technology, including usage frequency and commonly selected areas, and clarify the library's core positioning in their learning and daily life.
2. Analyze users' satisfaction with key environmental factors such as acoustic and light environment, temperature and humidity, spatial layout, seating configuration, and supporting facilities from the perspective of environmental psychology, identifying core variables affecting user experience.

3. Grasp users' needs and expectations for library space and facilities, and construct a scientifically sound and feasible micro-renovation plan to improve the library's spatial environmental quality and user satisfaction.

2.2. Research Content

Systematically review core theories of environmental psychology, including density perception theory, privacy protection theory, and sensory adaptation theory, along with relevant research results on university library space design and user satisfaction, constructing the theoretical foundation and analytical framework of this study [5].

Design a targeted questionnaire to collect feedback data from faculty and students of Shenyang University of Technology regarding usage frequency, environmental satisfaction (noise control, lighting, ventilation, temperature, etc.), spatial layout satisfaction, facility configuration satisfaction, commonly used areas, and improvement needs [6].

Perform statistical analysis on the survey data to clarify users' current usage, satisfaction distribution characteristics, core needs, and existing problems, revealing the relationship between environmental factors and user satisfaction [3].

Based on environmental psychology theory and survey results, propose specific micro-renovation plans for issues in the library's acoustic and light environment, temperature and humidity, spatial layout, furniture facilities, and supporting services [7].

Summarize research findings, point out limitations, and provide an outlook on future spatial optimization and service upgrading trends for university libraries [8].

3. Case Study and Analysis

3.1. Survey Design

3.1.1. Survey Participants

The survey targeted all registered undergraduates, postgraduates, and faculty members of Shenyang University of Technology. A random sampling method was employed to distribute questionnaires [9]. A total of 51 valid responses were collected, comprising 38 undergraduates (74.51%), 10 postgraduates (19.61%), and 3 faculty members (5.88%). The sample represents users from various educational levels and roles, ensuring a certain degree of representativeness.

3.1.2. Survey Instrument

Based on relevant research findings and library management practices, the "Questionnaire on Current Usage and Satisfaction with the Library of Shenyang University of Technology" was developed. The questionnaire encompasses six dimensions: usage frequency (1 item), environmental satisfaction (noise control, lighting, ventilation, temperature, etc., 11 items), spatial and facility satisfaction (spatial layout, open space, number of seats, etc., 5 items), interference factors (1 item), factors influencing comfort (1 item), and commonly used areas along with improvement needs (2 items), totaling 21 items [10]. It includes both single-choice and multiple-choice questions, ensuring comprehensive and focused content.

3.1.3. Survey Implementation

The questionnaire was distributed via the WJX online survey platform in December 2026. A total of 60 questionnaires were disseminated, yielding 51 valid responses. This resulted in an effective response rate of 85%, which satisfies the requirements for statistical analysis [11].

3.2. Analysis of Case Survey Results

3.2.1. Reference Cases from Peer University Libraries

Three provincial key universities of the same type (University A, University B, University C) were selected for case reference [11]. Their primary optimization directions and corresponding outcomes are summarized as follows:

1. University A: Focused on noise control by implementing zoned sound insulation designs, such as soundproof panels in quiet zones and sound buffer zones in interactive areas, along with noise-canceling headphone rental services. Noise control satisfaction improved from 62% to 85%.
2. University B: Addressed seating and privacy limitations by reorganizing the spatial layout, introducing individual study cubicles, and incorporating adjustable-spacing desks and chairs. Seating satisfaction increased from 58% to 79%.
3. University C: Enhanced the lighting system by integrating a smart linkage mechanism between natural and artificial lighting and installing anti-glare curtains in window-side areas. Lighting satisfaction rose from 65% to 82%.

3.2.2. Preliminary Comparison of Survey Results for Shenyang University of Technology Library

Compared with peer universities, the library of Shenyang University of Technology demonstrates above-average performance in noise control (66.67% positive evaluation), spatial layout (66.66% positive evaluation), and ventilation (64.7% positive evaluation). However, challenges such as furniture comfort (only 11.76% of users did not consider this factor as core to comfort), the need for additional reading space (96.08% user demand), and sunlight glare (60.78% of users experiencing varying degrees of interference) are more prominent and require targeted improvements [12].

4. Analysis of Current Usage and Satisfaction Results for Shenyang University of Technology Library

The preliminary survey findings and usage patterns are summarized below to provide a clear overview of the library’s current status [13] (As shown in Figure 1).



Figure 1. Summary of Preliminary Survey Findings for Shenyang University of Technology Library

4.1. Usage Frequency Analysis: High-Frequency Use Is Significant, Core Learning Space Clearly Positioned

The survey results indicate that the weekly library usage frequency among faculty and students is predominantly 3 to 5 times, representing 68.63%. Usage frequencies of daily visits, 1 to 2 times per week, and once per month or less account for 7.84%, 11.76%, and 11.76%, respectively. These findings highlight the library's role as a central space for daily learning and research activities, with substantial high-frequency utilization. Consequently, the quality of the environment and the level of services provided directly influence the learning experience and efficiency of most users [14] (As shown in Figure 2).

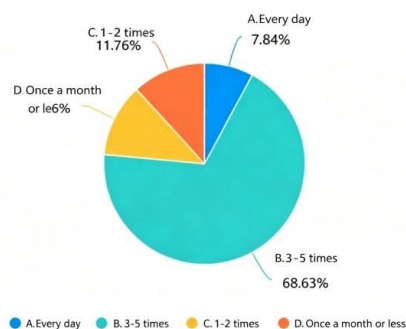


Figure 2. Distribution of Weekly Library Usage Frequency among Faculty and Students.

4.2. Environmental Satisfaction Analysis: Generally Positive Evaluation, Local Issues Prominent

4.2.1. Noise Control: Mostly Positive, Room for Improvement

The proportions selecting "very good" and "good" are 25.49% and 41.18%, respectively, totaling 66.67%. This indicates that most users acknowledge the library's noise control effectiveness [15]. However, the combined proportion of "poor" and "very poor" responses, totaling 21.56%, highlights that noise interference persists in certain areas, such as the boundaries between interactive and quiet zones and near elevator entrances. These findings suggest the need for further improvements in zoned sound insulation measures (As shown in Figure 3, 4).

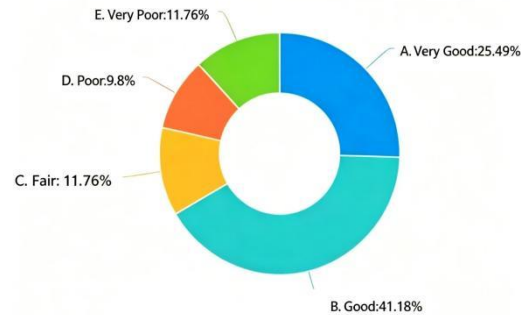


Figure 3. User Satisfaction Evaluation of Library Noise Control.

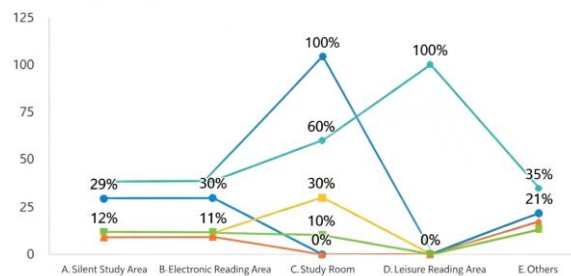


Figure 4. Comparative Analysis of Noise Satisfaction Across Different Functional Zones.

4.2.2. Lighting Conditions: Generally Satisfactory, Glare Problem Urgently Needs Solving

Users' satisfaction with the library's lighting conditions (natural and artificial lighting) shows "very satisfied" and "satisfied" proportions of 35.29% and 31.37%, respectively, totaling 66.66%, indicating generally good satisfaction. However, the proportion of "not satisfied" totals 27.45%. Combined with Q12 results (43.14% occasionally affected by direct sunlight or glare, 31.37% often or always affected), the lighting issues are mainly concentrated in sunlight glare interference and uneven brightness of artificial lighting in some areas, requiring targeted adjustments [16] (As shown in Figure 5, 6).

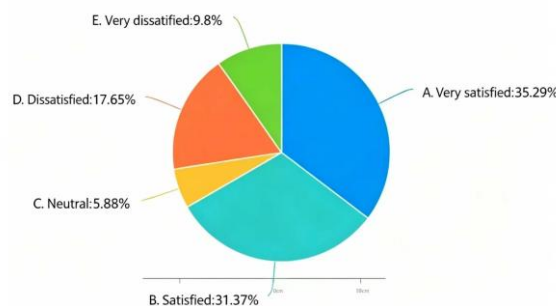


Figure 5. User Satisfaction Evaluation of Library Lighting Conditions.

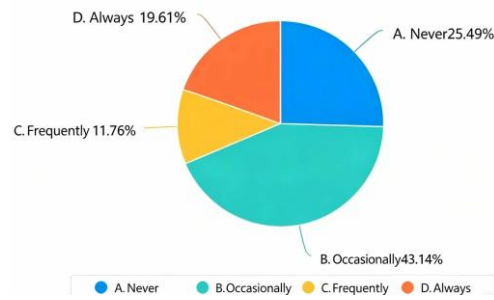


Figure 6. Frequency of User Interference Caused by Direct Sunlight or Glare.

4.2.3. Ventilation and Temperature: High Comfort, Minor Adjustments Needed in Local Areas

Regarding ventilation, the proportions of "very satisfied" and "satisfied" are 31.37% and 33.33%, respectively, totaling 64.7%; most users recognize the library's air circulation and quality. However, 13.73% select "very dissatisfied," potentially linked to ventilation issues in certain enclosed areas, such as study rooms [17]. Regarding temperature, "very satisfied" and "satisfied" account for 33.33% and 31.37%, respectively, totaling 64.7%, indicating generally good comfort levels. "Average" and "dissatisfied" together account for 25.49%, which may be associated with seasonal temperature variations, suggesting a need for enhanced precision in air conditioning controls (As shown in Figure 7, 8).

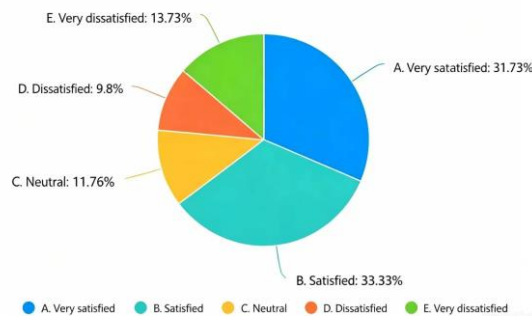


Figure 7. User Satisfaction Evaluation of Library Ventilation Quality.

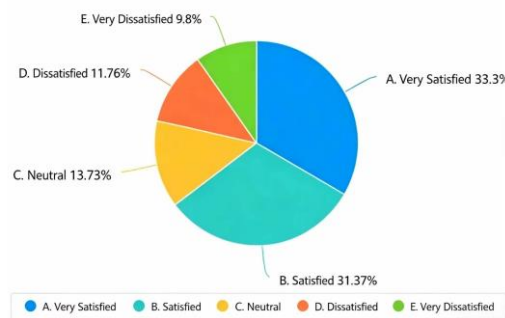


Figure 8. User Satisfaction Evaluation of Library Temperature Comfort.

4.3. Spatial and Seating Satisfaction Analysis: Layout Reasonable, but Strong Demand for Space Expansion and Privacy

4.3.1. Spatial Layout and Open Space: Generally Recognized, Need to Optimize Space Utilization Efficiency

Regarding spatial layout, the combined proportion of respondents selecting "very satisfied" and "satisfied" is 66.66%, indicating that more than two-thirds of users recognize the current layout [1]. Regarding open space, the proportion selecting "very sufficient" and "sufficient" reaches 64.7%, suggesting that it generally meets user needs; however,

17.65% still consider it "very insufficient," reflecting a notable mismatch between open-space supply and user demand during peak periods, such as examination weeks (As shown in Figure 9, 10).

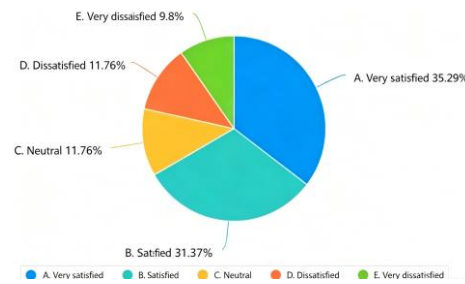


Figure 9. User Satisfaction Evaluation of the Library's Spatial Layout.

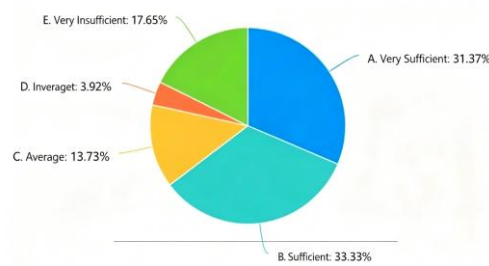


Figure 10. User Perception of Open Space Sufficiency.

4.3.2. Seating Quantity and Spacing: Sufficient Quantity, Privacy Needs Improvement

Regarding seating quantity, the proportions of "very sufficient" and "sufficient" are 27.45% and 41.18%, respectively, totaling 68.63%, indicating that the overall number of seats can meet user needs. However, regarding seating spacing and privacy, the proportion selecting "unsatisfactory" and "highly unsatisfactory" totals 27.45%, indicating that in some areas, seat spacing is too narrow and privacy measures require improvement, potentially impacting user focus [13] (As shown in Figure 11, 12).

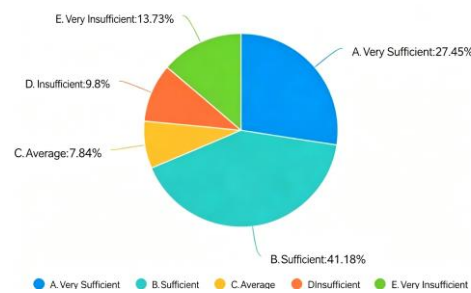


Figure 11. Evaluation of Library Seating Quantity Sufficiency.

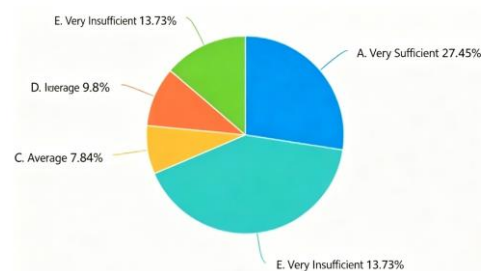


Figure 12. User Satisfaction with Seating Spacing and Privacy Protection.

4.4. Supporting Facilities and Acoustic Zoning: High Satisfaction, Details Need Improvement

4.4.1. Supporting Facilities: Generally Recognized, Some Facilities Need Upgrading

The combined proportion of "very satisfied" and "satisfied" is 62.74%. Most users express positive feedback regarding supporting facilities such as water dispensers, restrooms, elevators, and charging ports. However, 21.56% report lower satisfaction levels. Based on user feedback, the primary concerns include inconsistent water temperature from certain water dispensers, an insufficient number of charging ports, and the need for more frequent restroom cleaning [13] (As shown in Figure 13).

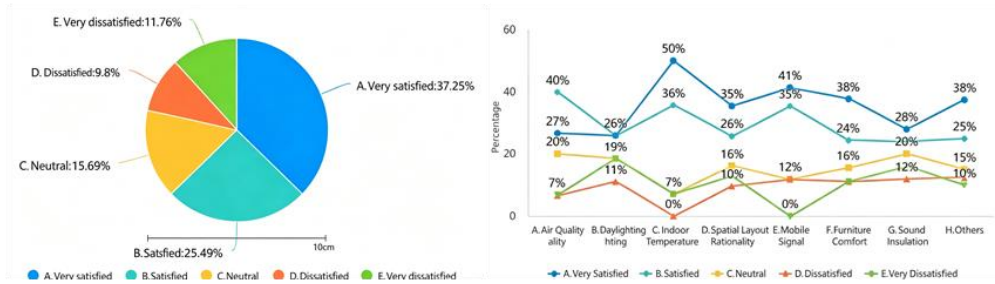


Figure 13. Overall Satisfaction Evaluation of Library Supporting Facility

4.4.2. Acoustic Zoning: Effective Zoning, Isolation Effect Needs Strengthening

The proportions of "very satisfied" and "satisfied" are 31.37% and 33.33%, respectively, totaling 64.7%, indicating that most users recognize the current isolation between quiet and interactive zones [3]. However, 15.69% report dissatisfaction, primarily due to unclear zoning boundaries and rule violations, such as talking in quiet zones. This highlights the need for improved zoning signage and stricter management measures (As shown in Figure 14).

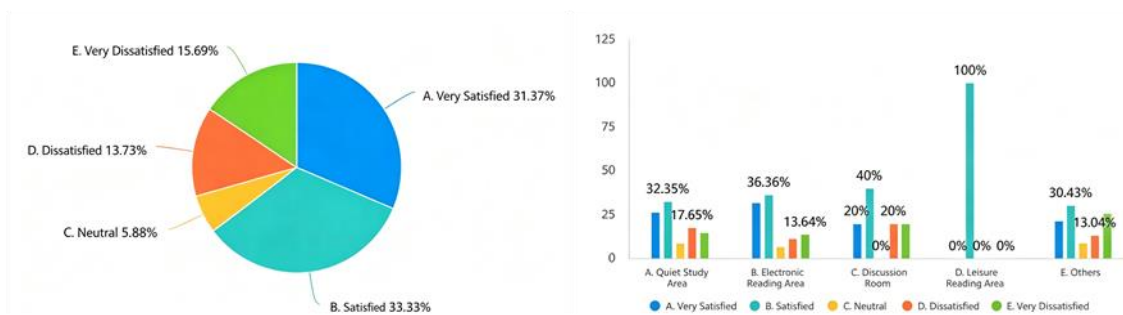


Figure 14. Comprehensive Multi-Factor Satisfaction Trends for Environmental Quality Indicators.

4.5. Factors Affecting Comfort and Needs Analysis: Furniture Comfort and Space Expansion as Core Demands

4.5.1. Core Factors Affecting Comfort: Furniture Comfort Ranks First

The multiple-choice results indicate that 88.24% of users regard furniture comfort as the primary factor affecting comfort, a proportion significantly higher than that of other factors, including noise interference (78.43%), spatial crowding (60.78%), and lighting (52.94%). This suggests that users are most concerned with the comfort of library furniture, such as desks and sofas. Existing furniture may present issues such as excessively hard seating surfaces and inappropriate desk heights, which may adversely affect the overall user experience [13] (As shown in Figure 15, 16).

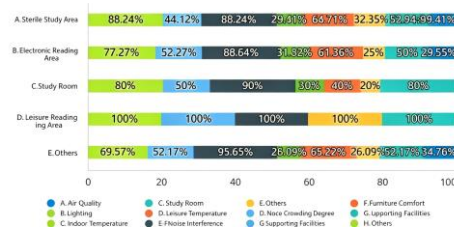


Figure 15. Comparative Analysis of Facility Satisfaction Across Major Study Areas.

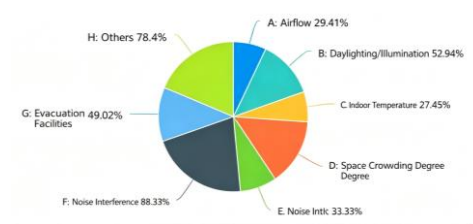


Figure 16. Core Factors Affecting User Comfort (Multiple-choice Results).

4.5.2. Commonly Used Learning Areas: High Demand for Electronic Reading Area

A total of 86.27% of users select the electronic reading area as their preferred learning space, surpassing other areas such as the quiet study area (66.67%) and study rooms (19.61%). This suggests that the equipment configuration and spatial environment of the electronic reading area better align with user requirements [3, 4]. Nonetheless, this high usage also highlights significant spatial pressure and increased facility wear in this area, necessitating targeted optimization efforts (As shown in Figure 17, 18).

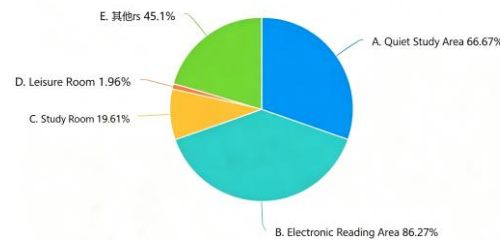


Figure 17. Distribution of Commonly Used Learning Areas among Library Users.

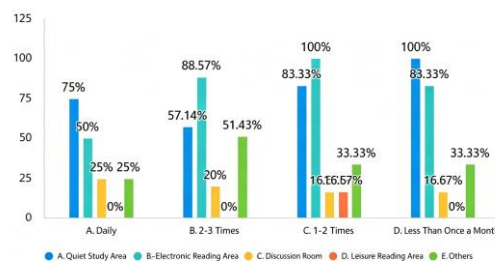


Figure 18. Usage Frequency Statistics for Different Functional Learning Areas.

4.5.3. Improvement Needs: Expanding Reading Area Is the Primary Demand

A significant majority of users, 96.08%, prioritize the need to "expand the reading area," making it the most prominent demand. Other notable preferences include "adding discussion areas" (84.31%), "expanding self-study areas" (62.75%), and "increasing basic supporting facilities" (72.55%). These findings highlight users' strong desire for enhanced spatial arrangements, alongside substantial expectations for improved facilities and optimized functional zones [8] (As shown in Figure 19).

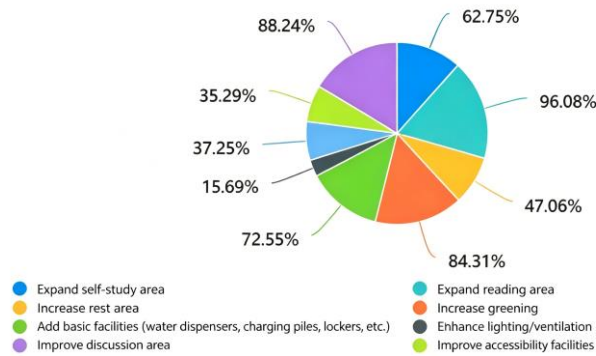


Figure 19. Distribution of Primary User Demands for Library Space and Facility Improvement.

4.6. Summarize Opinions and Provide Recommendations

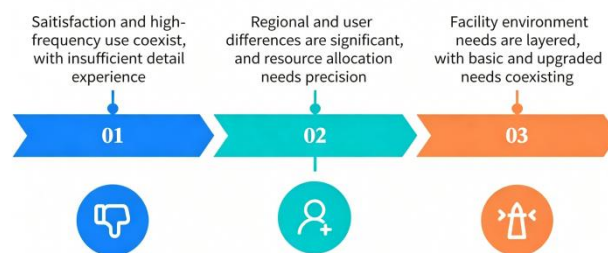


Figure 20. Summarized Opinions Regarding Library Service and Environment Conflicts.

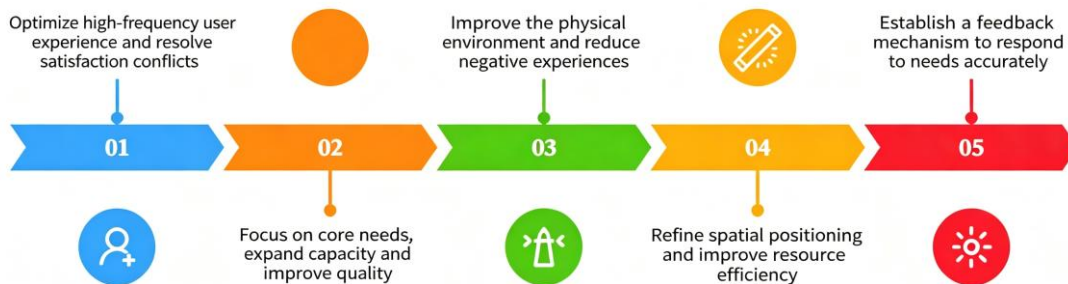


Figure 21. Strategic Roadmap for Library Spatial and Functional Optimization.

5. Analysis of On-Site Temperature and Humidity Experiment Data for Shenyang University of Technology Library

5.1. Introduction to the Temperature and Humidity Experiment

In May, we conducted a temperature and humidity measurement experiment in the third-floor reading space of the Shenyang University of Technology Library. The experiment was conducted from 8:00 to 20:00, with temperature and humidity measured in the south and north reading rooms on the third floor at six to seven different time points [16] (As shown in Figure 21).

5.2. Analysis Conclusion of Temperature and Humidity Environment Comfort

Based on the on-site temperature and humidity measurement data from the third-floor south and north reading rooms (8:00--20:00) in May, combined with the environmental psychology theory of "thermal comfort" and the human body's optimal temperature and humidity standards (temperature 18--24°C, relative humidity 40%--60%), a systematic analysis of the library's temperature and humidity environment comfort yields the following conclusions:

5.2.1. Analysis of Temperature Environment Comfort

(1) Overall Temperature Distribution Characteristics

Significant temperature fluctuations by time period: At 8:00, the initial temperature is concentrated between 23.6--24.0C, at the lower limit of the human comfort range; from 12:00 to 16:00, the temperature peaks, with core reading areas rising to 24.0--25.0C, with some areas exceeding the 24C comfort upper limit; after 18:00, the temperature gradually drops, stabilizing at 22.7--24.1C at 20:00, returning to the comfort range [17].

Obvious regional temperature differences: Affected by direct outdoor sunlight, the south-side window areas generally have higher temperatures than the north-side and central atrium areas, with a difference of about 0.3--0.8C; the public rest and study areas, due to higher user density, are 0.2--0.5C warmer than surrounding bookshelf areas and seminar rooms; high-floor corner areas (far from air conditioning outlets) easily reach 24.5--25.0C from 12:00 to 16:00, becoming zones with elevated temperatures.

(2) Comfort Evaluation

The proportion of comfortable duration meets the standard overall: During the two periods of 8:00--10:00 and 18:00--20:00, about 85% of the area maintains a temperature of 18--24C, with users generally feeling comfortable, consistent with the 64.7% positive temperature satisfaction rate in the questionnaire survey.

Local overheating during peak hours is prominent: From 12:00 to 16:00 (the period with the strongest daily sunlight and highest user density), about 30% of the area exceeds 24C, of which 20% reaches 24.5--25.0C, in a "slightly hot" state, which can easily lead to user distraction and increased fatigue, consistent with some users' feedback that "the reading area is too hot in summer."

Insufficient precision in regional temperature control: Areas near air conditioning outlets have lower temperatures (22.7--23.0C), while corners and window-side areas have higher temperatures, creating an "uneven heating and cooling" phenomenon, reflecting that the air conditioning system's air supply coverage is uneven and fails to achieve precise temperature control based on regional characteristics.

5.2.2. Analysis of Humidity Environment Comfort

(1) Overall Humidity Distribution Characteristics

Humidity changes over time follow a "U" curve: At 8:00, humidity is highest, reaching 72.9--101.3% in core areas, with some areas exceeding 100% (near condensation); from 12:00 to 14:00, humidity drops to its lowest, concentrated at 50.7--56.0%; after 18:00, humidity gradually rises, reaching 54.3--59.0% at 20:00.

Regional humidity differences are negatively correlated with temperature: Due to higher temperature and better ventilation, the south-side window areas have lower humidity than the north-side enclosed areas, with a difference of about 3--5%; restroom surroundings and seminar rooms, being enclosed spaces, generally have higher humidity, reaching 75%--85% at 8:00, easily causing a damp feeling; the central atrium area, due to strong air circulation, maintains humidity at 52%--56%, the most stable distribution.

(2) Comfort Evaluation

Mid-afternoon humidity comfort is optimal: From 12:00 to 16:00, about 90% of the area has humidity in the ideal range of 40%--60%, the air is dry, with no damp or dry discomfort, providing a good environmental foundation for prolonged study.

Morning high humidity needs focused attention: At 8:00, about 45% of the area has humidity exceeding 60%, of which 25% has humidity $\geq 75\%$, a "high humidity" environment, prone to book and desk dampness, and may cause respiratory discomfort for some users, consistent with the 13.73% "very dissatisfied" evaluation of ventilation in the questionnaire [4].

Slightly high humidity at night: At 20:00, about 20% of the area has humidity of 57.5--59.0%, close to the 60% upper comfort limit; prolonged exposure to such humidity may cause a sticky skin sensation, affecting the learning experience [6].

5.2.3. Comprehensive Evaluation of Temperature-Humidity Synergistic Comfort

(1) Limited Duration of Synergistic Comfort

Only from 12:00 to 14:00 does approximately 70% of the area simultaneously satisfy the synergistic comfort standard of "temperature 18--24C + humidity 40%--60%." During

other periods, either one or both indicators exceed the standard: 8:00 is characterized mainly by "high humidity," 16:00 by "high temperature," and at 20:00, some areas exhibit "both high temperature and humidity" (temperature 23.5--24.1C + humidity 57.5--59.0%).

(2) Core Influencing Factors

Natural environmental disturbances: Diurnal temperature differences and variations in solar radiation intensity directly cause temporal fluctuations in temperature and humidity, with the south-side window areas being most significantly affected; insufficient ventilation system efficiency: Morning high-humidity areas are mainly ventilation dead zones (e.g., seminar rooms and corner seats), where poor air circulation leads to moisture accumulation; lack of coordinated temperature-humidity control: The current air-conditioning system regulates only temperature without linkage to humidity, resulting in frequent occurrences of "temperature meets the standard but humidity exceeds the standard" or "humidity is appropriate but temperature remains unbalanced."

5.2.4. Core Conclusions

The temperature and humidity environment of the library at Shenyang University of Technology generally meets basic user needs, but notable "temporal and spatial" comfort deficiencies persist. Key issues include localized high temperatures between 12:00 and 16:00, elevated humidity levels at 8:00, limited precision in temperature and humidity adjustments, and uneven regional distribution. These challenges correspond to the "human sensitivity to temperature-humidity synergistic perception" described in environmental psychology's "thermal comfort" theory, which explains why some users rate the library's environmental comfort poorly. Future renovations should prioritize optimizing temperature control during peak hours, enhancing ventilation in areas with high morning humidity, and upgrading systems for coordinated temperature-humidity management to transition from "general compliance" to "comprehensive precision comfort."

6. Existing Problems in the Indoor Space of Shenyang University of Technology Library

According to the survey findings and the analysis based on environmental psychology theories, several issues have been identified within the indoor space of the library.

6.1. Insufficient Acoustic and Light Environment Regulation, Affecting Concentration and Sensory Experience

Noise control challenges include inadequate boundary isolation in acoustic zoning, leading to poor noise management near elevator entrances and restrooms. Additionally, violations of user rules, such as playing mobile phone audio in designated quiet zones, remain unaddressed, disrupting the principle of minimizing noise for optimal environmental conditions (As shown in Figure 22).

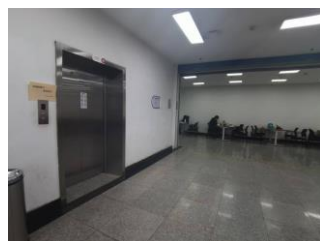


Figure 22. Existing Noise Control Blind Spot Near the Elevator Entrance.

The lighting system exhibits poor adaptability, with issues such as improper use of natural lighting causing direct sunlight and glare in window-side areas, which negatively impacts visual comfort [9]. Furthermore, uneven brightness and unsuitable color temperatures in artificial lighting, such as the use of cool white light that induces visual

fatigue, fail to align with the sensory adaptation requirements for lighting environments (As shown in Figure 23).



Figure 23. Visual Discomfort Caused by Direct Sunlight and Glare in Window-Side Reading Areas.

6.2. Local Imbalance of Temperature, Humidity, and Air Quality, Reducing Environmental Comfort

1. Insufficient precision in temperature control: Certain areas, such as high-floor reading spaces, experience inadequate heating performance and significant temperature fluctuations during seasonal transitions [11]. This fails to meet the "thermal comfort" principle, which specifies a comfortable temperature range for the human body between 18°C and 24°C.

2. Ventilation dead zones: Enclosed spaces, such as study rooms and corner seating areas, suffer from poor air circulation and reduced air quality, negatively impacting user health and learning efficiency. These conditions do not align with the "air quality optimization" principles of environmental psychology [6, 12]. Additionally, natural light is underutilized in indoor environments, leading to dim, damp, and poorly ventilated spaces. Curtains are frequently drawn, relying solely on artificial lighting, which results in considerable resource inefficiency (As shown in Figure 24).

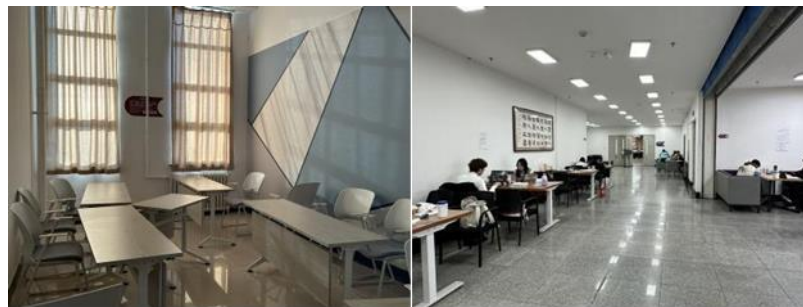


Figure 24. Current Status of a Ventilation Dead Zone and Insufficient Natural Light Utilization.

6.3. Unreasonable Spatial Layout and Seating Configuration, Coexisting Supply-Demand Contradiction and Privacy Deficiency

High-frequency areas such as the electronic reading area and self-study area have insufficient space, leading to a prominent supply-demand contradiction during peak hours [9, 10]. This results in excessive user density and discomfort associated with overcrowding, violating the "density perception" theory's requirement for reasonable spatial density.

In some areas, seat spacing is too narrow, causing significant visual interference between users and a lack of independent learning spaces. This does not meet users' need for personal space as described by the "privacy protection" theory, potentially impacting focus and productivity [5] (As shown in Figure 25).



Figure 25. High User Density and Crowding in High-Frequency Study Areas.

6.4. *Poor Adaptability of Furniture and Facilities, Inadequate Comfort and Practicality*

Existing desks and chairs exhibit issues such as excessively hard seating surfaces, unsuitable desktop heights, and improper back support angles [13]. Prolonged use of such furniture can lead to physical discomfort and fatigue, undermining user well-being and violating the principles of ergonomics and environmental psychology regarding comfort.

Facility configurations often fail to align with user requirements. For instance, the lack of sufficient charging ports in corridor study areas and the presence of aging water dispensers with compromised water quality diminish the functionality and efficiency of these spaces (As shown in Figure 26).

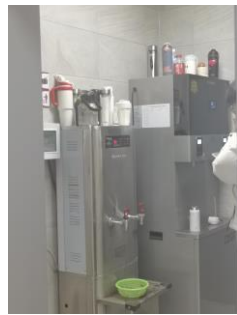


Figure 26. Current State of Aging Water Dispensers and Limited Charging Facilities.

6.5. *Imperfect Spatial Signage and Management, Affecting Ease of Use*

1. The zoning signage for acoustic and functional areas, such as electronic reading zones and self-study sections, lacks sufficient prominence. This results in users often misunderstanding the intended functions of these areas, leading to frequent violations of established rules.
2. The current management mechanisms are inadequate in addressing rule violations, such as noise disturbances and prolonged seat occupation. The absence of effective supervision and guidance systems negatively impacts the overall spatial order and user experience.



Figure 27. Current State of Spatial Signage and Library Management Issues.

7. Micro-Renovation Plans for the University Library Based on Environmental Psychology

Drawing on the principles of environmental psychology and addressing the specific challenges faced by the library at Shenyang University of Technology, micro-renovation plans are proposed across six dimensions: acoustic and lighting conditions, temperature and humidity control, spatial organization, furniture and facilities, auxiliary services, and management systems. These plans aim to be practical, targeted, and cost-effective.

7.1. Acoustic and Light Environment Micro-Renovation: Optimize Sensory Experience, Improve Concentration

7.1.1. Noise Control Renovation (Based on "Noise Minimization" and "Zoned Isolation" Theories)

(1) Strengthen zoned sound insulation design: Install detachable soundproof panels at the boundaries of acoustic zoning (e.g., between quiet and interactive zones) (height 1.8 m, thickness 5 cm), using sound-absorbing materials (e.g., polyester fiber acoustic panels) to reduce sound transmission; set up sound buffer zones (width 1.5 m) at elevator entrances and restroom doors, laying acoustic carpets to minimize door closing and footsteps noise [11, 17].

(2) Improve quiet zone control measures: Install prominent "quiet zone" signs at the entrances of quiet zones (using fluorescent materials, visible at night); equip sound level indicators (real-time decibel display, automatic reminder when exceeding 50 dB); provide free noise-canceling headphone rental services (initially 50 units, placed at the first-floor service desk) to meet users' need for a quieter environment; establish a rule violation reminder mechanism, with a supervision team composed of library staff and student volunteers to gently remind users of rule violations such as talking or playing mobile phone audio in quiet zones [6].

(3) Optimize equipment noise control: Centralize printers, copiers, and other equipment in an independent "equipment area" and install soundproof doors to reduce equipment operation noise [5] (As shown in Figure 28).



Figure 28. Proposed Noise Control Solutions: (Left) Structural Layers of Wall Soundproofing and (Right) Real-Time Decibel Monitoring System.

7.1.2. Lighting System Renovation (Based on "Sensory Adaptation" and "Visual Comfort" Theories)

(1) Anti-glare and sunlight control: Install adjustable anti-glare curtains (made of linen material, 70% light blocking, height adjustable) in window-side areas to prevent direct sunlight on desktops; equip desktops with adjustable desk lamps (dual-mode warm white and cool white light, brightness adjustable) to meet users' personalized lighting needs; renovate ceiling lights, replacing them with anti-glare LED lights (color temperature 4000K, color rendering index ≥ 85) to minimize direct light exposure to the eyes [9].

(2) Smart lighting integration: Install human + light sensor smart lighting systems in the electronic reading area and self-study area; lights automatically activate when ambient brightness falls below 300 lux and deactivate 10 minutes after personnel leave, ensuring adequate lighting while conserving energy; use low-brightness night lights in corridors and stairwells (color temperature 3000K) to reduce harsh light exposure [14].

7.2. Temperature, Humidity, and Air Quality Micro-Renovation: Optimize Thermal Comfort, Improve Environmental Adaptability

7.2.1. Temperature Regulation Renovation (Based on "Thermal Comfort" Theory)

(1) Enhance the air conditioning system: Maintain the library's indoor temperature within a stable range of 18–24°C (22–24°C in summer, 18–20°C in winter). Adjust the direction of air conditioning outlets to prevent direct airflow onto seating areas. Introduce small mobile air conditioners in zones with suboptimal air conditioning performance, such as high-floor reading areas and corner seats (initially 20 units, with dynamic adjustments based on usage frequency).

(2) Introduce supplementary temperature control facilities: Provide adjustable blankets (light-colored, pure cotton material) in self-study and reading areas for users to access as needed. Establish temperature feedback forms at the service desk, enabling users to report localized temperature concerns in real time. The library will compile feedback and adjust air conditioning parameters on a weekly basis [3].

7.2.2. Ventilation and Air Quality Optimization (Based on "Air Quality Optimization" Theory)

(1) Enhance the ventilation system: Install small exhaust fans (power 50W, noise ≤ 30 dB) in poorly ventilated areas such as study rooms and enclosed corners, operating daily on a fixed schedule (8:00–22:00, running for 30 minutes every 2 hours). Regularly clean air conditioning filters (once a month) to maintain optimal air circulation quality [1].

(2) Improve air quality: Place green plants (select varieties known for absorbing formaldehyde and purifying the air, such as golden pothos, snake plant, and ivy) in various library areas, with one pot per 50m², to enhance air quality and alleviate visual fatigue. Additionally, place activated charcoal bags in restrooms and equipment areas (replaced monthly) to absorb odors effectively (As shown in Figure 29).



Figure 29. Proposed Air Quality Enhancement Measures: (Left) Adsorption Mechanism of Activated Charcoal and (Right) Integration of Indoor Greenery in Study Areas.

7.3. Spatial Layout Micro-Renovation: Optimize Spatial Density, Strengthen Privacy Protection

7.3.1. Expansion and Restructuring of Functional Areas (Based on "Density Perception" and "Demand Adaptation" Theories)

(1) Enhance the reading area: Repurpose part of the unused newspaper section on the third floor (approximately 50m²) into an electronic reading area, adding 30 reading seats (using single-student tables). Additionally, create temporary reading areas on both sides of the first-floor lobby (utilizing spare space, equipped with folding desks and chairs, accommodating 20 people) to alleviate space constraints during peak hours [4, 5].

(2) Improve discussion areas: Establish an "open discussion area" on the fourth floor (approximately 80m²), furnished with modular desks and chairs (each table seating 4–6 people), along with whiteboards and soundproof panels to support group discussions. Upgrade the existing study rooms (10 rooms in total) by installing soundproof doors, ventilation systems, projectors, and charging ports to enhance the user experience.

(3) Optimize traffic flow: Redesign the routes from the library entrance to various functional areas, incorporating prominent wayfinding signs (color-coded: blue for the electronic reading area, green for the self-study area, yellow for the discussion area) to minimize cross-traffic congestion. Introduce "peak hour diversion tips" (e.g., encouraging stair use during exam weeks) at elevator and stairwell entrances to reduce waiting times [9, 17] (As shown in Figure 30).

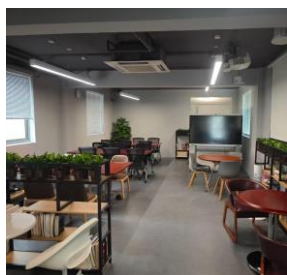


Figure 30. Optimized Layout for an Open Discussion Area to Accommodate Group Learning and Interaction.

7.3.2. Seating Configuration Optimization (Based on "Privacy Protection" and "Ergonomics" Theories)

(1) Increase private seating: Add individual study cubicles in self-study and electronic reading areas (size 1.2 m × 0.8 m, height 1.5 m), equipped with adjustable chairs and desktops, adding adjustable blackout curtains to meet users' need for independent space; convert some existing side-by-side desks and chairs into a staggered layout (increase spacing to 0.5 m) to reduce visual distractions.

(2) Optimize seat spacing: Increase the spacing of public area seats from the current 0.3 m to 0.4 m to ensure sufficient activity space; set up simple partitions between seats (height 0.3 m) to create visual separation without hindering communication, enhancing privacy (As shown in Figure 31).



Figure 31. Implementation of Individual Study Cubicles and Privacy Partitions to Enhance User Concentration.

7.4. Furniture and Facilities Micro-Renovation: Improve Comfort, Adapt to Diverse Needs

7.4.1. Furniture Upgrade (Based on "Comfort Experience" and "Ergonomics" Theories)

Replace core furniture: Gradually upgrade existing desks and chairs with ergonomic designs, starting with 200 sets prioritized for electronic reading and self-study areas. Chairs will feature elastic sponge material, adjustable backrest angles (90–120 degrees),

and adjustable desk heights (70–80 cm) to accommodate users of varying heights. The leisure reading area will be equipped with fabric sofas and small round tables to create a comfortable and relaxing space.

Optimize desktop configuration: Each desk will include reserved charging ports (two USB ports and one three-prong outlet), adjustable desk lamps, and pen holders. Storage baskets will be added beneath the desktop to organize items such as backpacks and books, ensuring a tidy workspace (As shown in Figure 32).



Figure 32. Principles of Ergonomic Sitting Posture (Left) and Key Adjustable Features of the Proposed Ergonomic Chairs (Right).

7.4.2. Supporting Facilities Improvement (Based on "Demand Adaptation" Theory)

Increase the number of charging ports in the electronic reading area, self-study area, and discussion area, ensuring one charging port per ten seats, with a total addition of 50 ports. Utilize wall-mounted designs to save space. Establish a shared power bank rental point in the first-floor lobby with 20 units to address temporary charging needs.

Optimize water dispenser configurations by selecting models that provide both hot and cold water with stable output. Ensure regular cleaning of water dispensers on a weekly basis, and place a cleaning record board next to each dispenser to facilitate user supervision.

Enhance accessibility facilities by adding ramps at the library entrance with a slope ratio of 1:12. Install Braille buttons and voice prompts in elevators. Reserve five accessible seats in self-study and reading areas, each with a width of 1.5 meters, equipped with armrests and charging ports to accommodate special user needs.

7.5. Supporting Services Micro-Renovation: Improve Convenience, Enhance User Experience

7.5.1. Smart Service Upgrading (Based on "Convenience" Theory)

(1) Implement a seat reservation system: Develop a library seat reservation mini-program, enabling users to reserve seats (individual seats, group seats, study rooms) 1 to 7 days in advance. Upon successful reservation, users can check in using a student ID or campus card. Reservations will be automatically canceled if check-in is not completed within 15 minutes, effectively addressing the issue of seat occupation.

(2) Enhance borrowing services: Install two self-service book checkout and return machines in the first-floor lobby, along with a book sterilizer. Introduce a "book proxy borrowing and return" service, offering free delivery twice a week for faculty and students located far from the library.

7.5.2. Detail Service Improvement (Based on "Humanistic Care" Theory)

(1) Establish a convenience service station: Introduce a convenience service station at the first-floor service desk, offering items such as umbrellas, reading glasses, adhesive bandages, motion sickness remedies, fever relief supplies, and phone stands for rental. Additionally, provide free drinking water and tissues to address users' immediate needs.

(2) Enhance rest areas: Create small rest areas (approximately 10m²) on each floor, furnished with sofas, green plants, and charging ports to allow users to take brief breaks. Display "quiet reminders" in these areas to minimize disturbances to other users.

7.6. Management Mechanism Micro-Renovation: Standardize Spatial Order, Ensure Renovation Effectiveness

7.6.1. Establish User Participation Mechanism (Based on "co-Construction and Sharing" Theory)

1. Form a user supervision committee: Composed of student representatives, faculty representatives, and library administrators (15 people in total), meeting once a month to collect user opinions and suggestions on the library environment, facilities, and services, ensuring timely adjustments to renovation plans.
2. Conduct satisfaction follow-up surveys: Conduct library satisfaction surveys quarterly, focusing on user feedback in renovated areas, and implement secondary optimization for projects with satisfaction levels below 80%.

7.6.2. Strengthen Rule Violation Control Mechanism (Based on "Order Maintenance" Theory)

(1) Clarify penalty rules for violations: Develop detailed guidelines for the use of library spaces, specifying penalties for issues such as noise interference, seat occupation, and facility damage (e.g., first-time reminder, second-time suspension of seat reservation rights for 1 week, third-time suspension for 1 month), and display these prominently on the library website and in all areas [3].

(2) Strengthen daily supervision: A supervision team composed of library staff and student volunteers (3–5 people on duty daily) conducts regular patrols and random spot checks to address rule violations. Monitoring equipment is installed in key areas (such as quiet zones and electronic reading areas) solely to assist in managing violations, ensuring privacy is not compromised [2].

8. Conclusion and Outlook

8.1. Research Summary

From the perspective of environmental psychology, this study systematically examined the current use patterns and user satisfaction of the library at Shenyang University of Technology through a questionnaire survey. The findings identified both strengths and limitations in the acoustic and lighting environment, thermal and humidity conditions, spatial layout, and furniture facilities. Overall satisfaction with the library was relatively high, and the frequent use of 3–5 times per week further confirms its role as a core learning space. Nevertheless, notable issues remain, particularly in furniture comfort, the adequacy of reading space, sunlight glare, and noise control.

In response to these issues, this paper integrated key environmental psychology concepts, including density perception, privacy protection, and sensory adaptation, and proposed micro-renovation strategies addressing the acoustic and lighting environment, thermal and humidity conditions, spatial layout, furniture facilities, supporting services, and management mechanisms. These strategies are oriented toward users' core needs and emphasize both precision and feasibility. Through low-cost and efficient interventions, they aim to enhance the comfort, adaptability, and orderliness of the library space, thereby better supporting the diverse learning needs of faculty and students.

8.2. Research Limitations

1. Limited sample size: Only 51 valid questionnaires were collected in this survey, which is a relatively small sample and may affect the representativeness of the results. Future research should broaden the survey scope and increase the sample size to improve the reliability of the conclusions.

2. Research dimensions need further development: This study mainly focuses on the influence of physical environmental factors on user satisfaction and does not address non-physical factors such as digital resources and service attitudes. Future research could further develop the research dimensions to provide a more comprehensive analysis of the factors affecting library service quality.

8.3. Future Outlook

With the continued development of higher education and the diversification of user needs, the spatial optimization of university libraries will remain a long-term task. Building on the current micro-renovation, the library of Shenyang University of Technology can further integrate smart technologies, such as intelligent lighting, smart air-conditioning systems, and AI-based voice navigation, to create a more human-centered smart learning environment. At the same time, it should strengthen exchanges and cooperation with other university libraries, draw on advanced renovation practices and management models, and continuously enhance service quality and overall operational effectiveness.

In addition, the application of environmental psychology in university libraries shows considerable potential. Future research may further examine differences in spatial needs among users from different disciplines, as well as changes in library space-use patterns in the post-pandemic context. Such studies can provide stronger theoretical support and practical guidance for the refined planning, construction, and operation of university libraries, thereby helping them develop into smart learning hubs that effectively support teaching, research, and academic engagement.

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