Enhancing User Experience: Improving the 24-Hour Self-Service Library with a Service Design Approach at Its Core

Shaotian Yin[1], Chulsoo Kim[2]

[1] Student, Industrial Design Discipline, Pukyong National University, Korea, yin591226195@163.com
[2] Professor, Industrial Design Discipline, Pukyong National University, Korea, kimchulsoo6@naver.com

Corresponding author: Chulsoo Kim

Abstract: Fast-paced life has become the norm in modern society.Therefore, the convenience of accessing books has become a critical reference for whether modern people can engage in reading. The emergence and application of 24-hour self-service libraries, with their two key features of self-service and proximity to users' lives, provide significant assistance in addressing this issue. This study uses questionnaire surveys, user interviews, on-site surveys and other methods to reveal the many problems that exist in the 24-hour self-service library service process and user use, such as low borrowing efficiency, low machine utilization, and poor service experience. Through research on service design,using service design tools, typical user persona models were developed, and user journey maps were created to extract user needs. By applying service design theories and methods, a design framework and tools for 24-hour self-service libraries were established, creating a new service model for 24-hour self-service libraries, with specific touchpoints designed. Optimize the service process of the 24-hour self-service library to further enhance the user experience before, during and after use. Ultimately, reasonable solutions were provided, completing the design of the 24-hour self-service library service system, highlighting the differences in service and user experience between pre-design optimization and post-design optimization. Finally, the feasibility of the proposed solution is verified through satisfaction evaluation criteria.

Keywords: Service Design, Service Process, Experience, Self-Service

1. Introduction

1.1 Research Topic Background

While neighborhood self-service libraries provide convenient public cultural services to a large number of citizens,they also have areas that require improvement and enhancement[1].The machine location and equipment usability and service issues are not only related to the investment and speed of self-service library construction, affecting the daily lending volume after the self-service library is built, but also largely determine the operating costs of the self-service library, thus affecting the cultural dissemination and social impact of the self-service library[2].Additionally, during the usage of self-service libraries, issues such as crashes, system errors, and low book dispensing efficiency occasionally occur and require urgent optimization and resolution[3].

According to the literature retrieved by the author on Google Scholar and various scientific research

platforms, research on self-service library services mainly includes policy, social services, service content, etc. Richard Sigwald mainly discusses customer and service staff satisfaction surveys in self-service libraries in Self-Service Customer Service Models in Libraries[4].Manuel B. Garcia mainly studied the redesign principles of self-service library service management systems based on human-centered interaction principles[5]. Most authors focus more on self-service in public libraries, which is inconsistent with the 24-hour self-service library as the research object of this article. As for the 24-hour self-service book machine, as a relatively new operating model, research in this area still remains in the aspects of commercial value and policy promotion. Zhou Lihong pointed out that the difficulties in promoting self-service book machines mainly lie in management issues and the hidden role of the government[6].Therefore, it is novel and feasible to intervene in the improved design of 24-hour self-service libraries from the perspective of service design systems and methods.

1.2 Research Methods

User Interviews: In this study, user interviews involved creating interview outlines, identifying target groups, and recording and analyzing responses in a question-and-answer format.

Questionnaire Surveys: In this study, questionnaire surverys were surveys are conducted to gather information about users' demographics, their usage of 24-hour self-service library facilities, their opinions and expectations regarding self-service libraries, and their satisfaction levels with various aspects.

Service blueprint: Service blueprint is a new service design method produced by the intersection of multiple disciplines. On the one hand, the service blueprint shows the entire process of users enjoying the service, and at the same time, it also clearly shows the front-end and back-up support of the service provider, rationally dividing the entire service into several levels and describing them line by line[7].

Service matrix diagram:The service matrix diagram lists the many elements involved in the service and looks for pairs of factors, which can clearly show the correlation between different elements. Designers can use the matrix diagram to quickly find the cross-service nodes of different objects to quickly find service nodes with problems. This can effectively solve the needs of service objects and the design pain points in the service process[8].

1.3 Research Objectives

This study aimed to categorize common user tasks and their associated workflows using user research methods, analyze pain points and user needs during the use of 24-hour self-service libraries, and provide design directions. It sought to optimize the service processes of 24-hour self-service libraries using relevant service design theories, further enhancing the user experience before, during, and after library usage. It emphasized the differences in service and user experience between pre-design optimization and post-design optimization, ultimately delivering reasonable solutions to optimize the design of the 24-hour self-service library service system.

2. Overview of Relevant Theories and Application Analysis

2.1 Overview of Service Design

The goal of service design is to meet user needs and deliver value to users. Service design thinking revolves around a thorough focus on both business and user experiences, systematically reflecting on and exploring innovative thinking patterns[9]. The service design process primarily comprises five key stages: discovery, definition, concept, prototype, and testing. By employing this process, it is possible

to identify and pinpoint issues that users encounter during the usage, make modifications to the corresponding task flows, and guide relevant hardware design. Additionally, the modified design can be validated and tested through the service design evaluation methods[10].Some of the relevant techniques and tools needed for service design research in this project include questionnaire surveys, on-site observation, user observation, user interviews, persona development, user journey mapping, and service blueprinting[11].

2.2 Current Development Status of 24-Hour Self-Service Libraries

The space occupied by the service model 24-hour self-service library is determined by the footprint of the self-service library service machine within the space. Different manufacturers produce service machines of varying sizes[12].

Specifically, a 24-hour self-service library system typically consists of five components: book display cabinets, self-service terminals, library inquiry terminals, book return collection boxes, and bulletin boards[13].
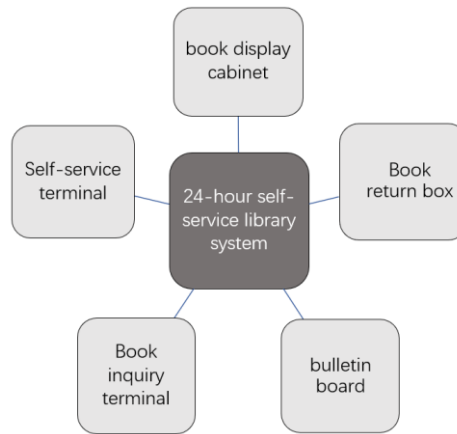
[Fig. 1] 24-Hour Self-Service Library System

The primary core technology of a 24-hour self-service library is its RFID (Radio-Frequency Identification) information recognition[14].This type of RFID technology primarily involves emitting high-frequency radio wave signals into the external environment to directly identify and acquire RFID data and textual information from a book[15].

[Table 1] shows examples of existing self-service book machines.

[Table 1] Existing Self-Service Library Cases

Area	Product Mame	Exterior
Effingham, Illinois, United States	Book Box	
Daegu, Korea	Smart Library	

Fuzhou,China	Fuzhou 24-hour self-service library	
Chongqing,China	Happy Bookstore	

2.3 Main problems of self-service libraries

Equipment Management Issues:Failures primarily occur in the self-service book borrowing and returning processes. For instance, due to malfunctions in the self-service devices, readers may click on the book they want to borrow, but the book does not dispense correctly from the slot, even though the reader's borrowing system displays the book as borrowed. Additionally, if a reader fails to place the book in the correct orientation, leading to a service machine's inability to recognize it, and if timely repairs are not made, readers within the entire service area may be unable to borrow books, thereby reducing their enthusiasm for reading[16].

Insufficient Promotion of Self-Service Libraries:While self-service libraries are strategically located in areas with relatively high foot traffic, they still lack adequate promotion[17]. Research found that platforms like YouTube, Naver, and KakaoTalk provide limited promotion of 24-hour self-service libraries.

Self-Service Library Cost-Benefit Issue: Establishing self-service libraries requires relatively low initial investment, but the later operational and maintenance costs can be high. In some cities, self-service libraries rely on revenue generated from book rentals by readers, which results in minimal income and makes it challenging to meet operational requirements[18].

2.4 Application of Service Design in the Design Analysis and Construction of the Design Process for Self-Service Libraries

Using the stages as shown in [Fig. 3], this paper sought to improve the current service processes of self-service libraries using the methodology of service design. This includes systematically summarizing and categorizing the issues based on the preliminary investigations, questionnaires, and telephone interviews. Through the application of service design methods, the overall service processes and relevant physical and digital touchpoints will be reconfigured to enhance service efficiency and user experience. Lastly, design recommendations and improvement directions will be proposed for both software and hardware, followed by final validation and testing.
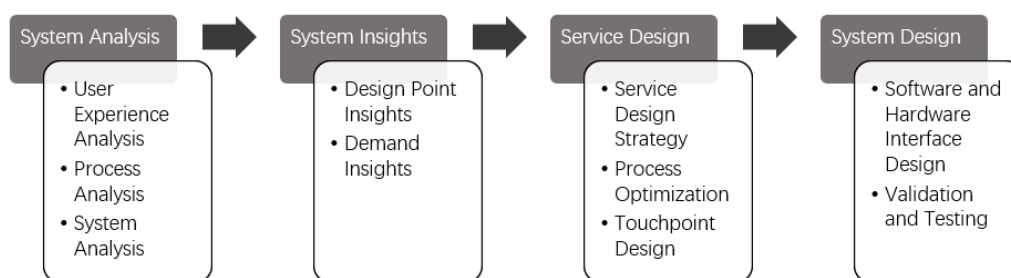

[Fig. 2] Design Process Construction

3. 24-Hour Self-Service Library User Research

3.1 Self-Service Library Target User Research

O -site visits and research on 24-hour self-service libraries were conducted within Busan City.This study will employed various research methods with the aim of gaining in-depth insights into the fundamental aspects of Busan citizens' usage of 24-hour self-service libraries and specific details during the usage process. These specific details encompassed research on user task types, user task operation behaviors, and other related information, with the objective of gaining insights into user needs and pain points.

3.2 Questionnaire Data Statistics and Analysis

Questions 1 to 4 pertain to the basic user demographics, including education, age, occupation, and gender as shown in [Fig. 4]. For gender distribution, the male proportion The male proportion accounts for 51%, while the female proportion is 49%. For age distribution, the age group between it can be observed that the age group between 19 and 30 is the most prominent, with 56 individuals. There were 17 respondents below 18 years of age, and 6 individuals above the age of 45. For educational background distribution, a significant proportion of a significant proportion of respondents have higher educational backgrounds. There are 39 individuals with undergraduate degrees and 34 individuals with postgraduate or higher degrees.
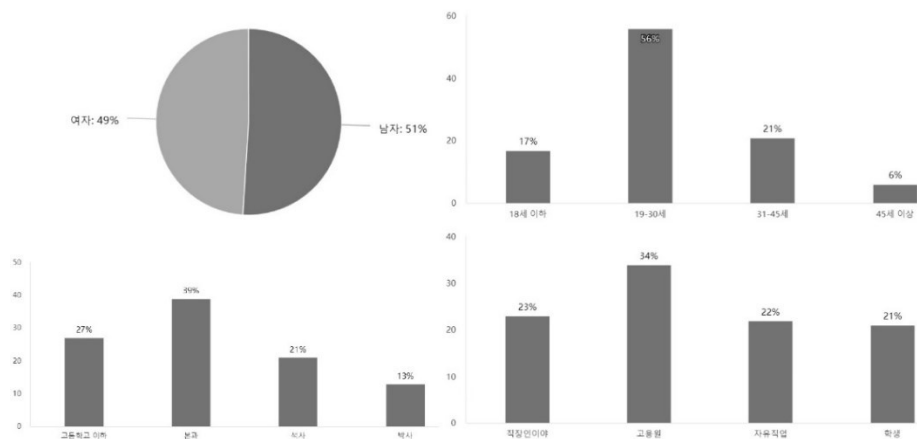
[Fig. 3] User Demographics Statistical Chart

Questions 5 to 9 aimed to understand the surveyed individuals' usage frequency, practices, and their awareness of the library's location as shown in [Fig. 5]. Over 60% of readers indicated that using the 24-hour self-service library saves them a significant amount of time. 40% of readers tend to choose libraries located in peaceful environments like parks for borrowing books. Regarding usage frequency, the majority of users, a total of 41, utilize the self-service library 6 to 10 times per month. Among the remaining respondents, 20 individuals borrow books 1 to 5 times a month, and 6 users have a more sporadic usage pattern, which is related to their reading habits. In terms of the distribution of usage time, the highest proportion of users, totaling 42, use the library on weekdays.
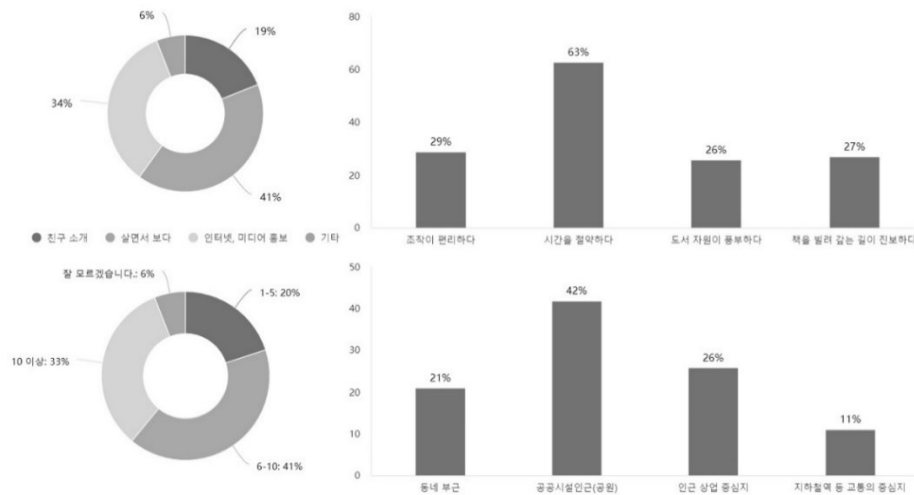
[Fig. 4] User Usage Information Chart

Questions 10 to 18 aimed to understand the surveyed individuals' attitudes, needs, and expectations regarding the current functions and services provided by the 24-hour self-service library, as well as to identify design opportunities as shown in [Fig. 6]. These questions effectively highlight the shortcomings and deficiencies of the self-service library. For example, 49 users expect simplified operations and features. Over 40% of users desire a combination of virtual and physical buttons for operation. 41 users wish to see self-service libraries located at public transportation hubs. Nearly 50% of users hope to access information about recommended books through the library machine. Most users frequently encounter issues such as the books they want to read being already borrowed and complex operations.
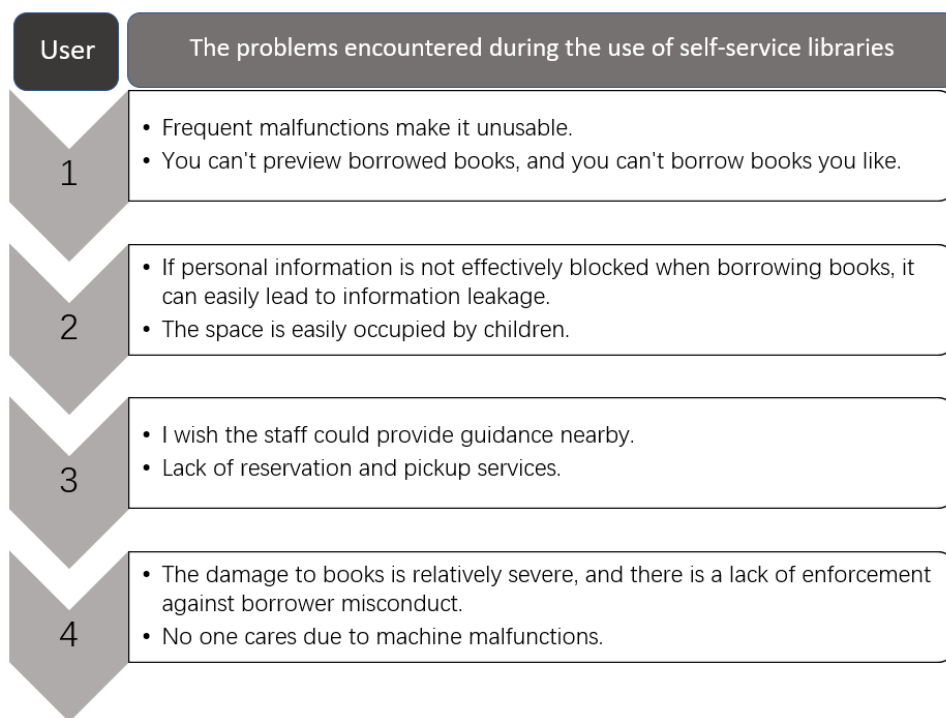
[Fig. 5] User Needs Analysis
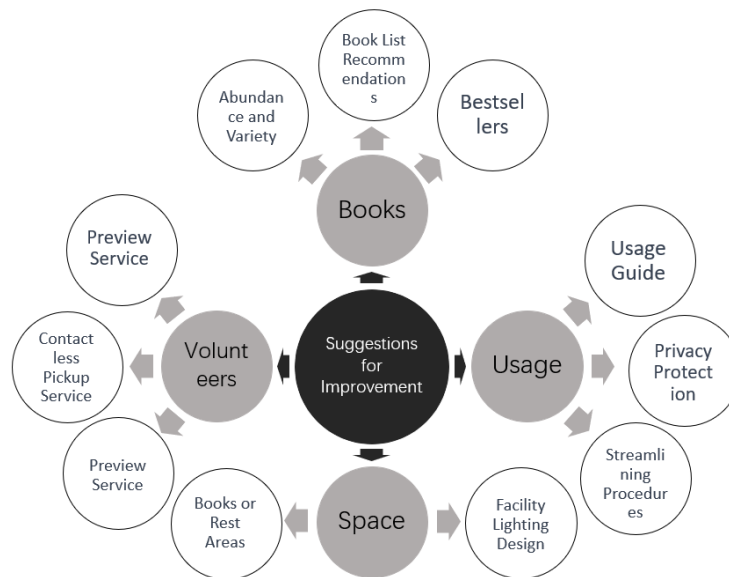
3.3 User Interviews

The following was the interview protocol employed in the study:
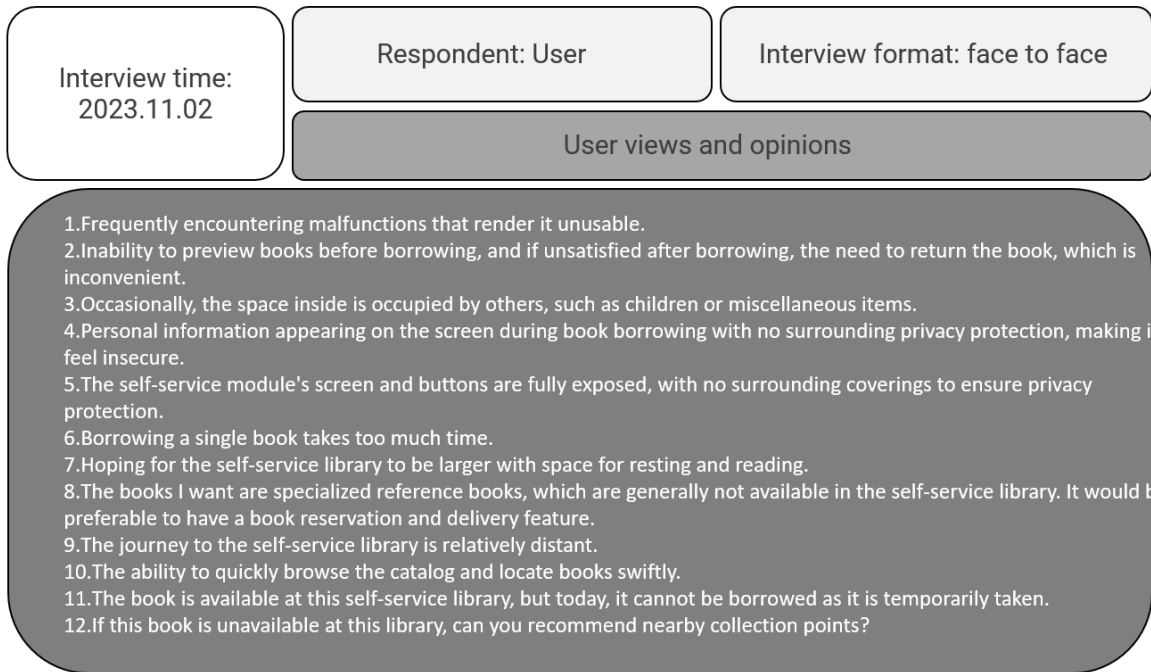
[Fig. 6] User Interviews

3.4 User Problem Categorization and Organization

The user suggestions for the 24-hour self-service library is shown in [Fig. 7] below.

[Fig. 7] Suggestions for 24-Hour Self-Service Library

Through the survey, it was found that users expressed the problems they encountered when using the

24-hour self-service library. Their responses were summarized into four major types of problems as follows: (1) When borrowing identification, personal information will be displayed on the device interface and the surroundings of the device. There is no obstruction, and privacy is not well protected; (2) Borrowing and returning books is a complicated process, and the efficiency of borrowing books is very low; (3) The limited book collection cannot meet the needs of users; and (4) There is lack of personalized reader recommendation content.

This chapter involves a study of users to understand the current usage status of the 24-hour self-service library, identify potential problems that users may encounter during their interactions, and collect user suggestions. In the present era of information technology and technological advancements, some self-service libraries may no longer meet the evolving needs of users.User pain points will be categorized and identified through specific task processes to provide optimization directions for the subsequent service design.

4. Demand Analysis and Service Design for 24-Hour Self-Service Libraries

4.1 Service Design Principles for 24-Hour Self-Service Libraries

Through research and summarization, it has been found that current user interactions within the 24-hour self-service library primarily involve membership registration, book selection, book return, book borrowing, and inquiries. It was also found that there is a lack of corresponding pre-borrowing reservation and inquiry services, as well as post-borrowing evaluation and feedback mechanisms.A comprehensive and holistic approach should be taken to consider the needs of users throughout the entire service phase. Each user interaction at the self-service kiosk interferes with a specific module, so the design principles should be proposed with consideration of various factors.

4.1.1 User-Centric Design Principles

Users are at the core of the design. User experience greatly affects the usage rate and revenue of self-service libraries. As a public facility, a 24-hour self-service library needs to consider designing a sense of belonging and emotional needs for users, providing services that exceed user expectations. Therefore, in the design process, it is essential to consider the sense of belonging when users are using the 24-hour self-service library, enhance its outreach among citizens, and maximize participation for every citizen. Also individual differences in needs should be fully taken into account, respecting the individual's role in the service[19].

4.1.2 Design Principles for Integrating Book Self-Service Systems

On one hand, it is necessary to consider all touchpoints generated by users' various task operations. On the other hand, currently, the 24-hour self-service library does not provide services for users before they arrive or after they leave. However, user research indicates that there are related needs before and after service. Additionally, the design should connect these user needs to create a unified and comprehensive service pathway. Developers should make it possible for users to smoothly manage relevant information between the borrowing machine and the personal information client[20].

4.1.3 Principles of Software and Hardware Usability and User-Friendliness

This principle refers to the ease with which users can navigate and operate the digital interface of self-service terminals. Through analysis, it was determined that the primary goal of the 24-hour self-service library is to enable users to perform a series of operations such as borrowing and returning books independently, without requiring external assistance.Therefore, the design should simplify the design

logic, avoiding complexity to prevent cognitive overload for users, and should provide a sense of direction for user operations[21].

4.2 User Journey Map Analysis

By establishing a user journey map [Fig. 8], typical user behaviors and the services provided by the 24-hour self-service library were analyzed in three main sections: pre-service, during-service, and post-service. User pain points were identified through this process and analyzed using service design theories and thinking to uncover user needs and design opportunities. This set the foundation for optimizing the functionality and addressing pain points in the 24-hour self-service library.

By breaking down the overall service process into three key stages with book borrowing and returning as critical touchpoints, the service design approach can be used to target various aspects of improvement within 24-hour self-service libraries. Firstly, in the pre-service stage, mobile applications can be leveraged to provide users with features for locating service points and checking book availability.This helps users understand the inventory status of books before arriving at the service points, improving efficiency, and reducing unnecessary travel[22].By capturing user emotions and experiences throughout the entire service process, the service to provide a more satisfying psychological experience for users can be adjusted and improved.
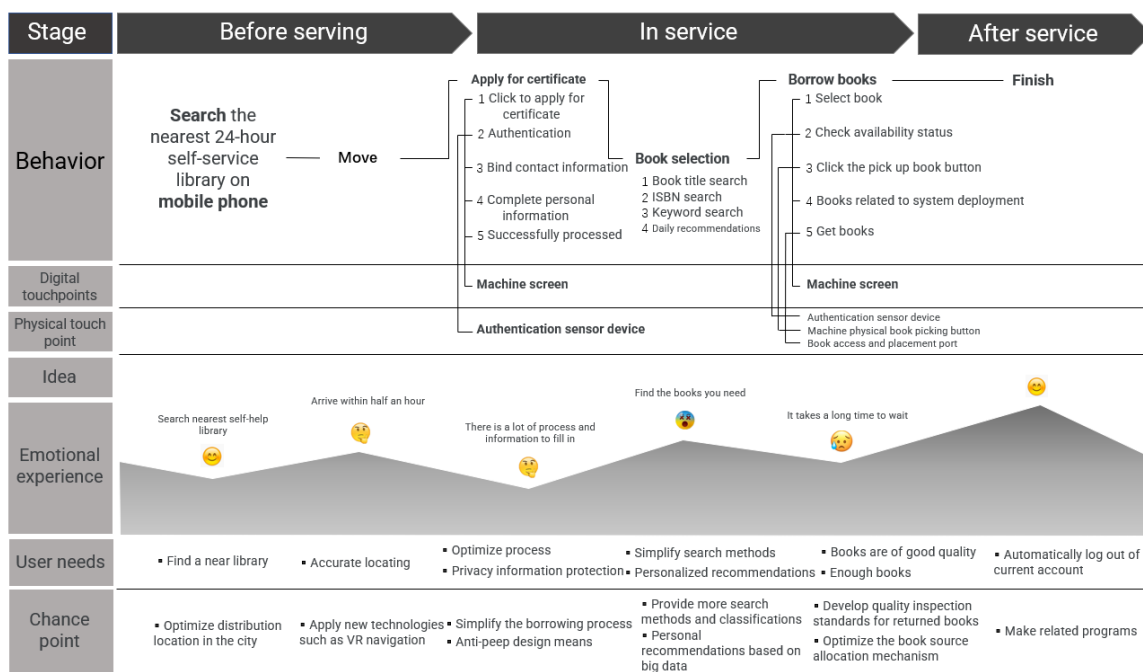
[Fig. 8] 24-Hour Self-Service Library User Journey Map

4.3 Problem Analysis and Exploration

Based on the division of service paths and stages in the user journey, the corresponding service pain points were organized and extracted:

(1) Before Service: Both types of users experience pain points before the service. For individual readers, the lack of knowledge about branch locations requires them to check through mobile applications. For family-oriented users, encountering device malfunctions is common, leading to uncertainty about the status of devices before visiting. Additionally, prior to borrowing books, users are

unaware of whether the self-service library has the desired books. For household users, borrowing multiple books at once leads to confusion about which ones to return.

(2) During Service: During the card application stage, personal information is displayed on the screen with no surrounding privacy protection. During the book selection and borrowing stage, books are enclosed in display cases, preventing users from browsing before borrowing. Users borrow books and then decide whether to read them, and if dissatisfied, they initiate the return process. During the return stage, when returning multiple books, users need to go back to the initial steps for each book, resulting in inefficient book return processes.

4.4 Design Concepts

Based on the user research in Chapter 3 and the user requirements summarized in Chapter 4, it is important to conduct a corresponding analysis of user needs with the key points of the 24-hour self-service library design. New touchpoints should also be introduced and existing ones should be optimized to enhance user experience. The summary is presented in [Fig. 10] below[23].

This figure emphasizes the need to introduce new digital or physical touchpoints (such as new service methods or features) during this process and optimize existing touchpoints (such as self-service terminals or application interfaces) to enhance the overall user experience. Improvements may include user requirements, relevant design changes and optimizations, and how to enhance user interaction with the self-service library. This process helps ensure that the design better meets user expectations and needs, improving the service quality and user satisfaction of the self-service library.

service level	user behavior	Demand Description	Design point	Contact type
Before service	Go forward	• View recent site locations • Figure out career path • Real-time network equipment book, operation status, etc. information • View book loan records online	By designing a mobile app for a 24-hour self-library, users can view the status of each site in real time on the mobile app, such as location information, operation status, book list, etc., and provide navigation and personal information to users. Can provide library inquiry function	Add digital contacts
In service	Document forgery	• Hide personal information when issuing certificates • Add forget certificate notification	• Hide device information • The ID detection area for self-operation of the terminal is designed horizontally, and the user is instructed to remove it through a speaker.	Digital touchpoint optimization
	Return book	• Return the book quickly	• Return rapid decline books through identity verification process	Digital touchpoint optimization
	Choose book	• personal reading space	• Design a position for users to sit	Physical contact optimization
		• Decide whether or not to borrow a book after previewing it • Pick up the book faster and put the book away	• Designing a quick bookshelf/drop corner allows users to receive books faster, open them, and borrow books if they like them.	Digital touchpoint optimization Physical contact optimization
	Borrow book	• Cell phone Certification • More numbers to choose from	• After receiving an independent ID card, users can authenticate their identity using only their mobile phone. • Optimize the structure of the 24-hour self-service library server to accommodate more books.	Digital touchpoint optimization Physical contact optimization
	Reserve	• Users can select the book they want	• Set up the ability to select books online and find books offline	Increase in number and physical contact points
After service	Leave	• Problem repair root	• Inquiry contact information can be displayed on the first screen of the terminal and on the mobile terminal.	Digital touchpoint optimization

[Fig. 9] Design Concept Diagram

4.5 24-Hour Self-Service Library Service Blueprint Planning and Design

This study aimed to propose an innovative self-service model centered around the service experience of citizens using the 24-hour self-service library. The goal is to design a self-service experience that better suits the users. Through the observation and analysis of user engagement in the activities of the

24-hour self-service library service process, and considering user pain points to meet their needs, the author optimizes the various processes and touchpoints of the existing self-service system. Based on the refined activity flow and relationships, an optimized service blueprint is designed. The service blueprint, through its organization, provides clearer guidance for the practical design of each touchpoint. [Fig. 11] shows te blueprint planning and design.
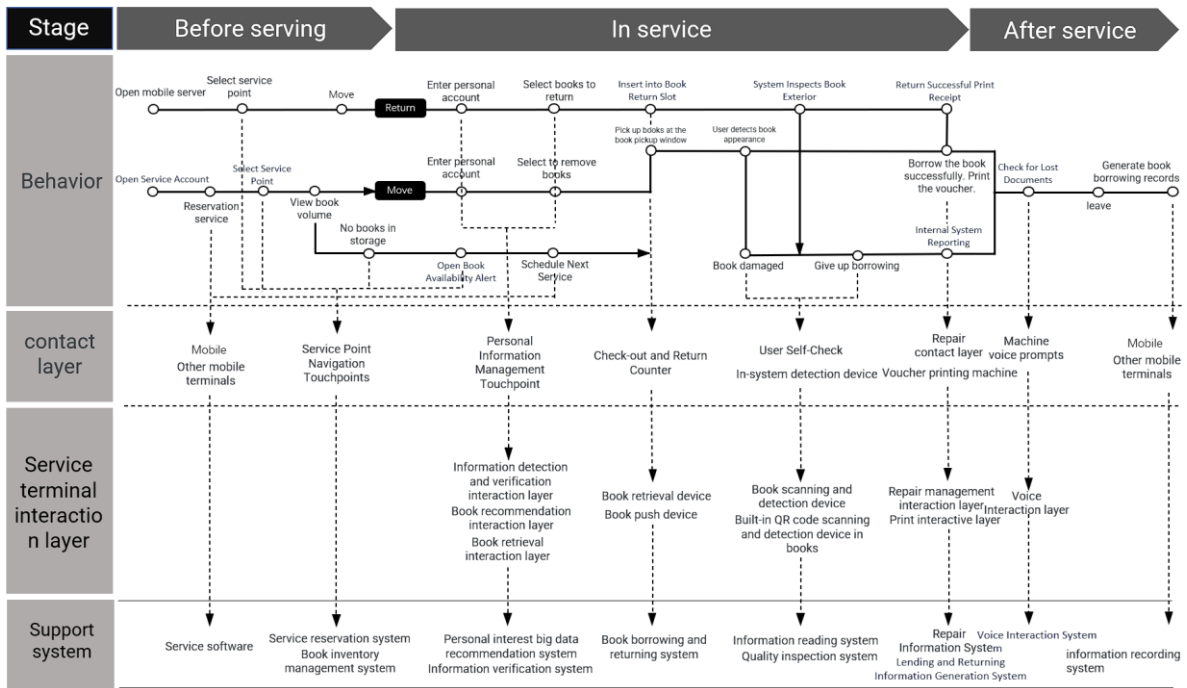

[Fig. 10] 24-Hour Self-Service Library Service Blueprint Planning and Design

4.6 Comparison Before and After Design Optimization

	Before serving	In service	After service
Before improvement	1 Difficulty finding the library address 2 Unable to check book inventory 3 Lack of reservation service	1 Returning books: Most machines usually require 7-8 steps to borrow books. 2 Preview: No preview function 3 Login: You need to enter your password to log in to the server. 4 Recommendations: Daily recommendations without personal interest 5 Interaction: Touch screen operation is not conducive to the elderly and children. 6. Returning books: It requires more steps to return books and is less efficient.	1 Fault repair: You need to make a phone call, which is more troublesome. 2 Failure occurs: no alternative solution 3 Items left behind: When items are left behind, there is no reminder function
After improvement	1 Intelligent map navigation (VR) 2. Smart client to view relevant book information in advance 3 Provide online reservation service	1 Returning books: Simplified process steps, 2-3 steps 2 Preview: Provide electronic information to preview the information on mobile phones and servers 3 Login: Quick login by face or NFC 4 Recommendation: Use personal information big data to filter books that users may like 5 Interaction: Combining physical and digital shocks 6 Returning books: Simplified process steps, 2-3 steps	1 Set up a one-click repair button to quickly handle faults 2 Automatically recommend nearby normal outlets and plan routes 3 voice prompts to prevent items from being left behind

[Fig. 11] Comparison Before and After Improvement Chart

4.7 Solution Testing and Evaluation
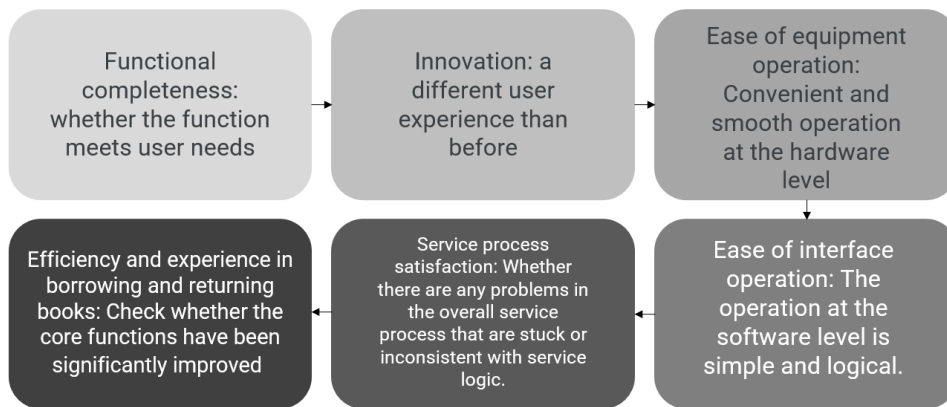
[Fig. 12] Design Plan Content Evaluation Chart

Based on the evaluation criteria related to service design and the key influencing factors in the service process, the following six elements for evaluating service quality satisfaction are proposed:

(1) Functional Completeness: The extent to which the functionality meets user demands; (2) Innovativeness: The innovation in the self-service experience; (3) Device User-Friendliness: The ease of operating the equipment; (4) Interface User-Friendliness: The ease of operating the interface; (5) Satisfaction with Service Processes; (6) Borrowing and Returning Efficiency and Experience.

4.8 Result

The specific research results are as follows:

(1) Output the optimized 24-hour self-service library service blueprint to improve the experience quality of the overall service process. After studying the current research status and service model of 24-hour self-service libraries, service design thinking is applied to the design optimization of 24-hour self-service libraries, and a design process and design strategy based on service design theory is proposed, and service design tools are used to construct Use the user journey map of the role model to discover the user's pain points and design opportunities, thereby outputting a design-optimized 24-hour self-service library service blueprint.

(2) Redesign key touch points to improve user experience in all aspects. Through service design related tools and user research methods, we carry out key contact optimization design based on the output service blueprint. By adding a digital touch point, users can learn about the operation status, location, and types of books in advance before going to the 24-hour self-service library branch, thereby improving the efficiency of borrowing books and improving the service process. Based on this series of program designs, a more complete user self-service process will be built.

5. Conclusion

Software level is a critical evaluation criterion for 24-hour self-service libraries, and the application of service design lays a solid foundation for improving service quality. With the continuous advancement of technology, we can anticipate improvements in the self-service library systems in terms of automation, user interfaces, and user experiences. Therefore, more scholars are expected to get involved in this research field and drive the implementation of related research findings. On the other hand, the development of science and technology provides technical support for the advancement of intelligent self-service libraries. The use of technologies like 5G, big data, and artificial intelligence allows for

more efficient allocation and management of library resources within a region. These technologies can also help in building user profiles and offering precise book recommendations based on users' preferences.

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