



Studies on Techniques to Enhance Local Libraries' Public Space Quality--Using the Jiayu County Library in the Chinese province of Hubei, Xianning City, as an Example

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Abstract. Libraries have continued to grow as cultural needs improve. In the construction of public space, large libraries serve as city landmarks with diverse categories and perfect functions for the public. Local libraries in small cities are often more accessible to the public, but due to slower technological development and a lack of conceptual updates in these cities, there are still some deficiencies in the construction of public spaces at this level. Therefore, improvements and upgrades are needed to address these issues. This article proposes the characteristics of a high-quality library public space and discusses the ecological and functional features of excellent public libraries. Jiayu County Library in Xianning, Hubei Province, China serves as an example of the perfect space development, complete with a superior environment and functionalities. Targeted use of pertinent enhancement techniques is advised to raise the standard of the library's public areas and support the growth of cultural construction.

Keywords: local library, library public space, Jiayu County Library, urban renewal.

1 Introduction

Library is a significant culture venue in our daily lives. The 2022 edition of the IFLA-UNESCO Public Library Manifesto states that libraries play a vital role in ensuring that as many people as possible have access to education and the opportunity to engage in the cultural life of their communities and knowledge societies, especially true in developing nations^[1]. Public library development is specifically suggested as an active strategy in China's 14th Five-Year Plan^[2]. While big public libraries are crucial for fostering cross-cultural interactions and enhancing the city's reputation, tiny neighborhood libraries are vital. Local libraries are more accessible to the general public than major libraries, serving as hubs for cultural events, neighborhood exchanges, and the development of community cohesion.

Nowadays, the library hardware construction developed rapidly, however in some places, there are still some libraries which did not possess the progressive of concepts and means, so the library does not offer users a better reading experience. In some county-level cities, although there are libraries in the physical building, there are still some issues like insufficient functions of the library zoning, poor lighting in the building, noise impact, and derivatives of the cultural function is single, and so on.

2 Characteristics of high-quality library public space

Excellent library public space has many characteristics, such as being spacious and comfortable, quiet and warm, functional, and so on. In the information age, the library public space and the combination of emerging technologies, they have developed a diverse range of derivative functions. After comparing and analysing, it is briefly summarized as ecological quality and functional quality.

The natural environment affects and restricts the service effectiveness of the library's physical space^[3], and also determines the ecological quality of public space. One of the relevant factors in the evaluation of indoor environmental comfort is the comfort of its physical environment, such as sound, light, heat, and other elements of the physical properties of the natural or artificial environment in line

with the requirements of human comfort^[4], a good natural environment is the guarantee of good ecological quality of public space.

In the information age, libraries' traditional roles are merged with new technologies to create vibrant, new functions. At the same time, new functions are developed for functional blocks that accommodate the public's varied needs for cultural derivative activities, like catering and cultural activities. Local libraries should have functional features that are consistent with their local characteristics, taking into account the demands of the times and local culture.

2.1 Ecological quality

(1) Light environment.

In the library reading space, uniform lighting distribution is often a necessary condition for creating a good book reading environment, and poor lighting distribution will lead to some areas being excessively dim or excessively bright, which will bring discomfort and visual fatigue to the readers^[5]. The Library Building Design Code JGJ38-2015 stipulates that the standard value of illumination from the side windows of the reading rooms of libraries in China is 450 lx^[6].

Meanwhile, the 2019 version of the Green Building Evaluation Standard has a total evaluation score of 12 points for public buildings that make full use of natural light^[7](Table 1):

Table 1. Light Environment Indicators and Retrofit Measures in Green Building Evaluation Standards

Standard	Score	Retrofit measures
The proportion of the area in which the lighting coefficient of the interior area meets the lighting requirements reaches 60%	3 points	Improve the window glass to a glass type with a larger transmission ratio, replace the ceiling finish and flooring material to a material type with a larger reflection ratio, and improve the indoor lighting by using a light guide tube if necessary.
Indoor main functional space at least 60% of the area proportion of the area of the light illuminance value is not less than the number of hours of lighting requirements on average not less than 4h/d	3 points	
The ratio of the area of underground space with an average lighting coefficient of not less than 0.5% to the area of the first floor of the basement reaches more than 10%	3 points	The public reading space discussed in this paper does not include underground space, so it will not be discussed here.
Glare control measures are available for major functional rooms	3 points	Sun-shading devices and reflective panel equipment are employed both internally and externally.

In terms of natural lighting, the side window lighting design can be changed or replaced with blinds to increase the amount of natural light entering the reading area. Also on the top floor, it is better to open the skylights on the roof for lighting. In this way, the working surface can be lighted more evenly and brightly by skylight lighting. Which means Illuminance, measures how much light an object receives per unit area of measurement and how much the surface is illuminated overall^[8].

In terms of artificial lighting, we should choose products that meet national safety standards. The color temperature of the light is 4000~6000k, which is neutral natural light with a bright feeling, suitable for public reading areas. Night light color temperature should be about 4000k, help to create a relaxing and warm, relieve fatigue learning and reading atmosphere at night. In terms of energy saving, you can choose more energy-saving materials to replace the daily use of a large number of incandescent lamps, but also in libraries using solar battery lighting systems, such as Spain's Pompeu Fabra Public Library, the use of solar power supply system for readers' activities and the bookstore to provide power for lighting^[9]. (Figure 1).



Fig. 1. Localized view of Pompeu-Fabra Public Library

Image Source: <https://barcelonaconcept.pl/architektura/library-upf/>
<https://www.upf.edu/documents/2963149/237016849/Biblioteca.jpg>

(2) Acoustic environment.

Indoor patrons can better focus by being in a good acoustic environment, like one with white noise. However, noise exposure can negatively impact physical, mental, and hearing health. The requirements for the acoustic environment in China's Green Building Evaluation Standards are that the noise level reaches the average of the low limit standard limit ($\leq 40\text{dB}$) and the high requirement standard limit ($\leq 35\text{dB}$) in the current national standard "Code for Sound Insulation Design of Civil Buildings" GB5018 [7][12].

In order to create a good acoustic environment, the library can improve its acoustic environment by planting more trees outside, paying attention to greening, and bringing in the natural sounds of wind-blown branches, insects, and falling leaves. Meanwhile, the interior space are equipped with "library-type white noise", such as the sounds of turning pages, rustling pens, footsteps, faint coughing, which need routine maintenance.

In order to improve the poor acoustic environment, the library should provide a special space for those who need to read aloud or recite. Additionally, building materials should be carefully chosen to offer the best possible sound insulation. The Harbin Institute of Technology library has a noise space section that extends its tangible functional division. This section includes areas for individual learning and seminars, immersive learning, music enjoyment, and diverse sound decibel levels^[10]. (Figure 2).



Fig. 2. Introduction of Harbin Institute of Technology Library Functional Division

Image source: <http://www.lib.hit.edu.cn/2022/0821/c14793a280276/page.htm>

(3) Air environment.

As an important service carrier of cities, public libraries are facing problems such as a large number of readers, limited natural environment, and relatively poor air quality. The reading area in libraries is more artificially controlled than other library spaces, and people's physical and mental well-being as well as their productivity are directly impacted by the indoor environment when they spend extended periods there.

For the indoor hygrothermal environment, the library should provide appropriate ventilation settings to acquire high-quality fresh air in hot and humid indoor environments while minimizing the use

of artificial ventilation systems. Reasonable ventilation techniques and suitable air conditioning systems, The Guangdong Zhongshan Library Renovation and Expansion Phase I Project is a low-energy building application demonstration project (Figure 3). Its exterior wall window sashes are pushed out to increase natural wind flow, allowing for the use of comprehensive natural ventilation in the spring, fall, and winter months instead of turning on air conditioning^[11].



Fig. 3. Partial view of Zhongshan Library in Guangdong Province

Image Source: Zhongshan Library of Guangdong Province Official Microblog

<https://weibo.com/2099154222/4810704458090596>

<https://weibo.com/2099154222/4841535596137539>

For indoor air quality, the main sources of pollution originate from persistent sources and intermittent pollution. For the former, it is important to use environmentally friendly and safe materials for indoor decoration and object purchasing, and control should start at the source. For the latter, the amount of greening on the building site should be increased. Green plants can play a large amount of carbon dioxide absorption, increase oxygen content, block dust, air purification, and other functions, to create a quality outdoor air environment. The indoor floor plan layout should concentrate on guiding the formation of through-the-hall winds and strengthening indoor and outdoor air convection, which can effectively reduce the concentration of indoor air pollutants. At the same time, optimize the design of door and window sizes, locations, and opening methods to obtain effective indoor natural ventilation^[12].

2.2 Functional Quality

(1) Traditional function of reading space.

Reading space functions should be adjusted according to the different needs of different groups of people. In terms of age, in the elderly reading area newspaper account for a large proportion, it is a good choice to set up a tea area, increase the guide slogans and enlarge their fonts, adjust the air-conditioning temperature, etc.; In children's area comics account for a large proportion, and it is necessary to adjust to the size of the tables and chairs and set up a parent-child reading area. Regional divisions should prioritize the needs of special populations with humanistic care. For instance, the Chongqing Library has a "reading room for the visually impaired" that is furnished with Braille books and periodicals, audio lending services, blind-specific computers, book amplifiers, and other equipment (Figure 4)^[13]. As technology advances, so too can science and technology be used to enable the creation of intelligent libraries. With the aid of mobile inventory carts, and other intelligent equipment, along with RFID, Zigbee, and other technologies, you can realize functions such as book anti-theft, automatic shelving, self-service borrowing and returning intelligent inventory, and more^[14].



Fig. 4. Partial view of Chongqing Library's "Reading Room for the Visually Impaired".

Image source: Chongqing Library official microblog
<https://weibo.com/1965632970/3370926597035712>
<https://weibo.com/1965632970/3437555636466256>

(2) Derivative Functions of Reading Space.

Compared with large libraries, county libraries carry less mobile populations and have relatively fixed populations during fixed hours, so they serve local populations and neighborhood acquaintances more often. Therefore, to a certain extent, local libraries have also assumed the function of providing a place for neighborhood activities. On the one hand, to meet the increasingly rich cultural needs of the public, libraries can provide academic lectures, thematic cultural exhibitions, and other cultural activities, to build a unique public space, to create a high-quality brand of public cultural services. For instance, the Vienna City Library offers an open space for the urban crowd and library users to rest and read on the rooftop terrace, to show movies and hold activities, as well as to stroll, watch, and converse^[15]. (Figure 5).

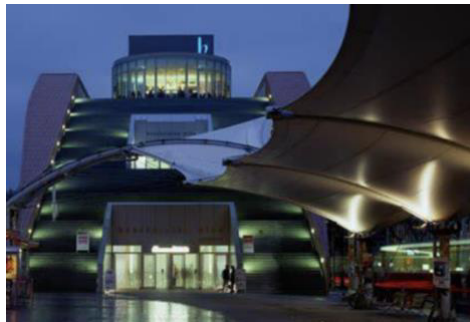


Fig. 5. Articulation of the Grand Staircase of the Main Library of the City of Vienna with the City Square.

Image source: <https://www.wien.info/en/art-culture/architecture/public-library-355990>

3 Strategies for improving the quality of reading space in libraries in Jiayu County, Xianning City, Hubei Province, China

3.1 Overview

Jiayu County belongs to Xianning City, Hubei Province. The county covers an area of 10,199.53 square kilometers, and in 2022, the resident population of Jiayu County was 289,300^[16]. The site of the library was selected in the county Chayan New District Development Avenue, covering an area of 4 acres, and a building area of 4,536 square meters.

The layout is as follows Table 2:

Table 2. layout

first floor	service hall, editorial department
second floor	electronic reading room, automation technology service department
third floor	reading room (newspaper reading room)
fourth floor	children's reading room, resource processing room
fifth floor	education and training department, multi-functional lecture hall
sixth floor	readers' activity room

It is a fully functional public cultural venue combining county set collection, reading, lectures, information processing, and activity services^[17].

3.2 Ecological insufficiency and improvement strategy

The Jiayu County library building now relies primarily on artificial lighting and large-load cooling to control the climate. This runs counter to the needs and usage of low-energy, healthy, and comfortable buildings.

(1)Light environment improvement strategy Regarding illumination.

The reading room's floor plan is low, and daylight is obstructed during the day. Between two bookshelves that block natural light from both sides—one on the left and one on the right—is the reading space. The majority of the inside is lighted by overhead lights, which is insufficient for the number of individuals utilizing the space that need seats. In addition, there is needless energy waste because every light in the vicinity is turned on simultaneously.

First and foremost, we can replace our daily reliance on incandescent lighting with more energy-efficient alternatives for artificial light sources. The first step in solving the natural light source issue is to rearrange the reading area and book storage area's arrangement. Next, consider adjusting the window area, namely the side windows that take the shape of shutters, to let more natural light into the interior of the space. (Figure 6).



Fig. 6. The current situation of the reading area of the library in Jiayu County and the idea of renovation. Image source: Author's drawing

(2) Sound environment improvement strategy.

The Jiayu County Library is situated alongside Development Avenue, which serves as the county's principal thoroughfare. There is poor greenery with largely low bushes on both sides of the road. Car whistles are the primary source of outside noise. The reading room is noisy, and the library section is not separated. This has an effect on some readers, which lowers productivity.

Based on this, the following measures are proposed to improve the acoustic environment in the library: putting trees in the green space outside the library to enhance the natural white noise environment and the green space; To lessen noise from the hallway entering the room, attempt to keep the front door closed or partially open; When to arrange it for the evening or relocate to another location. To lessen the effect of outside library noise on the library's interior, big trees, lawns, and sound barriers^[18] can be placed close to the building. (Figure 7).

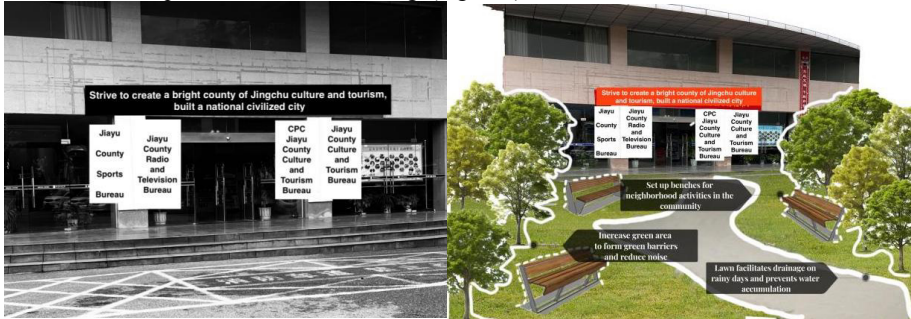


Fig. 7. The external public space and remodeling scenario of Garfish County Library

Image Source: Author's drawing

(3) Air environment improvement strategy.

The climate of Jiayu County is humid subtropical monsoon. With an average temperature of 4.5 °C, January is the coldest month while July is the hottest, with an average temperature of 29.2 °C^[16].

Indoor temperature in different seasons, wind speed, humidity, and other conditions of the subjective feeling are different, in the indoor artificial environment, regardless of the summer and winter, the indoor and outdoor temperature difference is too large easy to cause the human body's sense of thermal discomfort. Therefore, the region in the use of air conditioning refrigeration, to avoid air-conditioning refrigeration temperature is too low, the focus on the and overall circulation of the space to avoid western exposure and uneven cooling and heating in each space, thus creating a relatively comfortable indoor thermal environment.

3.3 Inadequate Functionality and Enhancement Strategies

(1) Enhancement of Traditional Functions.

The Jiayu County Library's reading area isn't allocated appropriately to accommodate specific groups' needs. The present space can be enhanced in this way. to expand the study and seminar space, the leisure and relaxation space, etc., while also providing excellent humanistic care for special groups with barrier-free amenities like blind alleyways, accessible elevators, and handicapped restrooms^[19]. Internal book borrowing, returning, and discovering processes are distinct and manual, which reduces efficiency. In this regard, it can be technologically empowered, using RFID, induction detection, biometrics, and other technologies to realize that out of the library that is borrowed, into the library that is returned, borrowing and reading zero stays, improve efficiency, and alleviate the pressure on the staff^[20].

(2) Derivative Function Enhancement.

Jiayu County Library is located on the side of the main road in the city, surrounded by large residential areas, which is the main place for local people to carry out cultural activities, so the county library also bears the responsibility of serving the surrounding population and driving the development of the surrounding cultural undertakings. In addition to literature lending, the library also provides lectures, exhibitions, training and other diversified services, so that the community neighbors feel the role of cultural drive. At the same time, Jiayu County has rich tourism resources, such as

natural hot springs, historical sites, etc., the county library should also assume part of the role of publicity and radiation.

4 Conclusion

We present the pertinent enhancement and improvement strategies using the library in Jiayu County, Xianning City, as an example and summarize the ecological quality and functional quality of its influence through reading and evaluating the pertinent information of local libraries. Local libraries and other local libraries can relate to this enhancement strategy. Increasing the general public's efficiency and convenience is the library building's basic value, which should be reinforced in all facets of public cultural services capacity building^[21]. To determine and consistently meet people's new expectations for a better life, it is necessary to gradually and orderly, step-by-step promote the combination of the library itself and the location of each library's characteristics and level of development around the needs of their service users.

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