



Research on the Image of University Campus Environment from the Perspective of Image Theory and Data Analysis

Taking Hubei University of Technology (HBUT) as an Example

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Abstract. With the rapid development of Chinese universities and the expansion of the number of students, how to use urban design analysis to study the built campus environment has become a primary issue. Based on the quantitative investigation and analysis of urban image theory, this paper compares the quantitative analysis results of the cognitive map of Hubei University of Technology campus, and obtains the cognitive intensity of five image elements on the campus of Hubei University of Technology (HBUT). The study found that mention rate of various elements of the campus gradually decreased along the two main axes of Chenxi Road and Zhongyang Avenue in the north and south directions; the imageability of various elements in the central area was significantly higher than that in other areas; the natural landscape element was the lake. An important feature of the campus image of the University of Technology; the campus lacks an environmental space with a strong cultural atmosphere. Finally, the results of space syntax analysis are compared and discussed, in order to improve the use efficiency and attractiveness of the campus environment space by Hugong University students, thereby improving the quality of the campus environment.

Keywords: image theory · city image · university campus · quantitative analysis of evaluation

1 Introduction

The university campus is the materialization of educational ideas. As the main place for college students to receive education and teachers to engage in scientific research, it embodies the connotation of campus culture and the frontier characteristics of social development. As Martin Pierce said: “Education is intangible, and campus buildings and spaces can materialize this intangible concept.” The quality of campus environmental space is directly related to the quality of the operation of the university knowledge community system. Since the expansion of university enrollment at the end of the last

century, the rapid expansion of China's higher education scale has been accompanied by the rapid development of modern urbanization. The construction of university campuses has experienced a construction climax for more than 20 years. In this process, the pursuit of scale, blind and extensive expansion, lack of more systematic and long-term planning and other practical issues. As the expansion of higher education in my country has slowed down in recent years, the construction of university campuses has gradually changed from an extensional incremental expansion to a connotative stock update. Multi-party consultation, flexible and sustainable planning method change (Wang Yan, 2018). It is of great significance to evaluate the campus construction and actual use in the past stage from the perspective of users.

2 Literature Review

In the 1960s, Kevin Lynch carried out research on "urban imagery" (Lynch, K. 1964–1995), proposing that the "imageability" of the environment is the readability and recognizability of space, and further summed up the "cognition of urban imagery". "Five Elements", this theory has become one of the main methods of modern urban research and has been continuously improved and expanded in its process of use. As a medium-scale urban space, university campuses have the characteristics of moderate scale, relatively single users, frequent contacts, and easy direct perception and cognition. Therefore, it is a good sample for research using image theory, and the research conclusions obtained are also more accurate.

In mainland China, in the 1990s, Hu Zhengfan and Lin Yulian introduced the theory of urban imagery into the analysis of university campus space in their book "Environmental Psychology", and conducted a comparative analysis of the campus imagery of Tsinghua University and Huazhong University of Science and Technology; Song Zefang, Zhou Yihu's (1994) monograph "University Campus Planning and Architectural Design" combines the "five elements of urban imagery" with the elements of spatial form, and sums up the inspiration of the five elements for the planning of campus space form; since 2000, the use of imagery has theoretical development case studies on-campus space emerge in an endless stream, involving nearly 100 university campuses.

From the perspective of the development process of research, affected by multi-disciplinary and technological progress, the application of digital technology and data collection and analysis methods has made the campus image more vivid. The research is more precise and nuanced. The theory of urban imagery and related research methods are important means to evaluate the spatial quality of the current campus environment and discover practical problems.

3 Research Objects and Methods Techniques

3.1 Research Object

The Hubei University of Technology (hereinafter referred to as "HBUT") was established in 1952 and has a history of 70 years. A multidisciplinary university with a wide range of university disciplines. HBUT is currently a single campus. It is located in Wuchang,

where Wuhan has the most colleges and universities. It is located in Hongshan District in terms of administrative division and is south of the overall location of the city. The campus covers an area of more than 1,500 acres, with a school building area of more than 1 million square meters and nearly 28,000 students (statistics from the official website of HBUT as of November 2021). The overall shape of the campus is approximately rectangular, with a length of about 1.8 km from north to south and a width of about 0.8 km from east to west. The campus is built along the river as a whole. The border on the east side of the campus is the Xunsi River, which originates from Bafen Mountain in Jiangxia District, Wuchang, with a total length of 16 km. Passing through universities and scientific research institutions such as HBUT, Hubei Academy of Agricultural Sciences, Wuchang Shouyi College, and finally entering the Yangtze River at Wutai Gate in Wuchang, it can be described as the “mother river” of HBUT and the “mother river” of many Wuhan universities. It has an important position in the natural landscape.

At present, the three gate entrances to the campus of the HBUT all have to pass through the three bridges on the Tounsi River. The western boundary of the campus is the Beijing-Guangzhou railway line. The campus is distributed in the plot area between the river and the railway as a whole, showing a trend of belt development. According to the plan, the campus is divided into five areas, east, west, south, north, middle, and the relevant areas are shown in Figs. 1 and 2.



Fig. 1. Campus satellite image (Image source: intercepted by Google Maps)

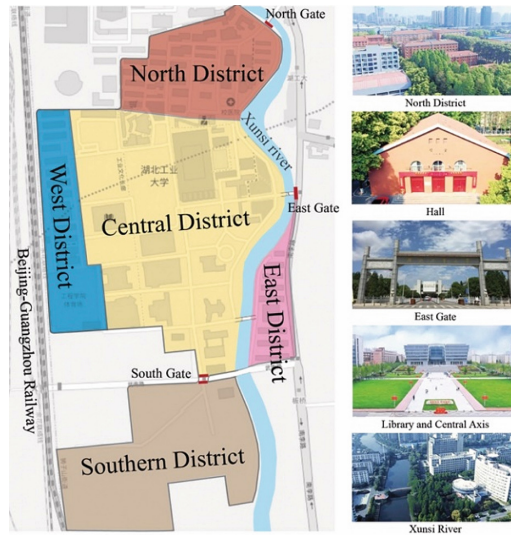


Fig. 2. Campus area distribution map (Image source: drawn by the author)

3.2 Research Methods

3.2.1 Cognitive Mapping

The researchers have a basic understanding of the spatial structure of the campus. Given that the dormitory areas of the North, West, and East are distributed in three dormitory areas of the same size, it is assumed that the students’ cognition of the campus image will be affected by the location of the dormitory (Fig. 3).

The average number of students in the three dormitory areas is drawn, to avoid the statistical data being too biased towards the cognition of a certain dormitory area. The sample population also includes a small number of teachers who have worked on campus for more than five years. The selected students and teachers are required to quickly draw a plane sketch of the campus of HBUT according to the legend without referring to any

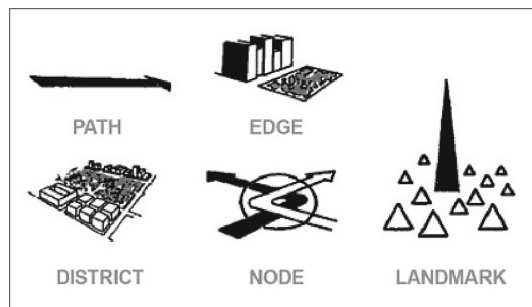


Fig. 3. The City Image and Its Elements (Image source: <https://ardicfurkan.wordpress.com/2019/10/03/the-city-image-and-its-elements/>)

navigation or map information and are required to mark the five most frequently visited places on campus, as well as to take graduation photos in the future required location. In the end, 120 cognitive map questionnaires were distributed, 98 maps were recovered, 88 maps were valid, and the effective rate was 89.8%.

3.2.2 Questionnaire Analysis and Quantification

While doing the cognitive map survey, more open-ended questionnaires and interviews were conducted with the selected subjects. Some of the questions in the questionnaire are repeated with the cognitive map, and the main purpose is to further confirm the vaguer expressions in the cognitive map. The questionnaire also includes questions about “cold knowledge on campus” and “what has been the biggest impact on campus life since the new crown epidemic?” The impact on campus cognitive imagery. A total of 120 questionnaires were distributed, and 82 valid questionnaires were recovered. The interview rule is to conduct interviews based on representative and special responses in the questionnaire to understand the reasons behind the image formation. In this study, the statistics of the questionnaire data were not included in the statistics of the frequency of mentioning the elements of the cognitive map, mainly as a supplement and confirmation of the map statistics.

4 Quantitative Analysis Results

According to Lynch’s city image theory, and according to the author’s cognition of the campus, it is preliminarily determined that the campus image of the HBUT is reflected in the five elements of the urban image (path, nodes, district, edge, landmarks).

The effective cognitive map data is classified and sorted, and the marked map is selected for the frequency statistics of campus spatial awareness. The imagery nodes in each cognitive map were marked with names, and their cumulative frequency of occurrence was counted to obtain the frequency table of imagery elements on the campus of the HBUT.

The spatial frequency of the mentioned image elements of the campus of HBUT is as follows (Table 1 and Fig. 4):

4.1 Path

The cognition of the main roads on the campus of the HBUT prominently reflects the geographical features of the campus and the basic skeleton of the grid. The main axis of campus psychological cognition is Chenxi Road (east-west direction) from the main (east) gate, Building No. 1 to the library, and the central avenue that runs through the north, central and south districts to form the basic axis of the cross of the campus. Most of the branch roads are separated from the main road and extend in all directions, linking open spaces and functional spaces of different scales, forming a spatial sequence with clear layers. In the compact square grid space, only the road along the river on the east boundary and the irregular plots on the north boundary break the strictness of the grid. It is worth noting that no matter in the cognitive map or in the questionnaire, few road

Table 1. Quantitative Statistics of Campus Image Elementsd.

Space name	Frequency (%)
Xunsi river	88.6
Library	88.6
East Dormitory	81.8
Main Entrance	81.8
West End Playground	79.5
Chenxi Road	79.5
Teaching the first Floor	79.5
Strawberry Garden Bridge	77.2
Teaching Building No. 2	77.2
Central Playground	77.2
Teaching Building No. 4	70.5
Westside Life Plaza	66.7
Central Canteen	63.6
Engineering Building	63.6
Teaching Building No. 5	61.4
Teaching Building No. 7	61.4
East Canteen	56.8
Riverside Avenue	52.3
Training Building	50
Industrial 6th Road	50
Central Avenue	47.7
School Clinic	45.5
West End Dormitory	43.2
Xiyuan Avenue	40.9
Hall	38.6
South Gate	38.6
Courier Point	36.4
Confucius Statue	34.1
Science Building	34.1
Liberal Arts Building	31.8
Pioneering Park	29.5
The square in front of the Library	29.5

(continued)

Table 1. (continued)

Space name	Frequency (%)
North District Dormitory	27.3
Industrial Cultural Corridor	25
North Canteen	25
Industrial 1st Road	25
Sycamore Avenue	22.7
Space	20.5
Administration Building	20.5
Agricultural Machinery Building	20.5
College Activity Center	20.5
Civil Building	18.2
Basketball Court (South)	18.2
Biochemical Building	18.2
Executive Building Turntable	18.2
North Gate Bridge	18.2
Railway	15.9
Stadium	15.9
Xiaodong men	11.4
Rock climbing	11.4
Industrial 4th Road	11.4
Industrial 3rd Road	9.1
Industrial 2nd Road	9.1
Badminton Court	9.1
Tennis Court	9.1
Basketball Court	9.1
Industrial 5th Road	9.1
Safety Education Base	9.1
Catfish Encounter Sculpture	6.8
Bank	6.8
Jingxiu Pavilion	6.8
Beiyuan 1st Road	6.8
The Roundabout of the School Hospital	4.5
East District Commercial Street	4.5

(continued)

Table 1. (continued)

Space name	Frequency (%)
Central Supermarket	4.5
Vegetable Market	4.5
National Training Center	2.3
Beiyuan 2nd Road	2.3
Primary School	2.3
Kindergarten	2.3
Southern District Canteen	2.3
The square in front of the Teaching Building No. 2	2.3

Data source: Author Statistics

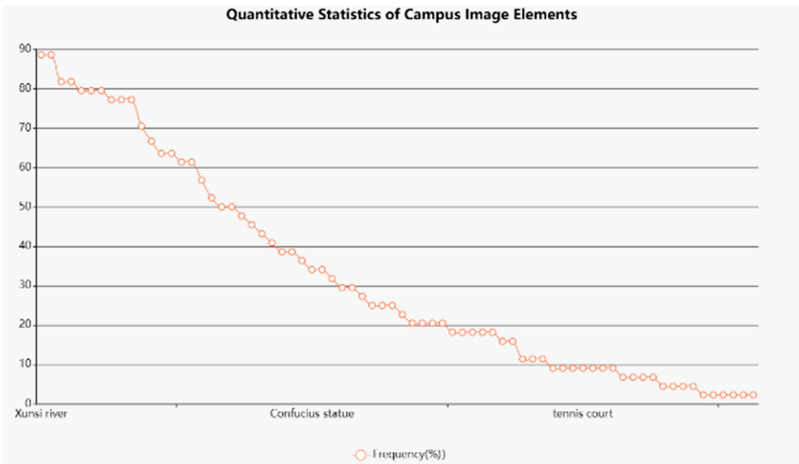


Fig. 4. Quantitative Statistics of Campus Image Elementsd (Image source: drawn by the author)

names can be clearly and accurately answered by the respondents, and most roads are confirmed by the respondent’s description of the location.

There is a lack of roads with cultural cognitive significance with historical precipitation. Among them, Wutong Avenue has a high mention rate (22.7) as a non-arterial road in the North District, and the relevant respondents can generally name the road, which has a strong imageability (Fig. 5).

4.2 District

In the planning scheme, the main campus of HBUT is divided into five areas: east, west, south, north, and middle. Each area has a relatively clear functional orientation, but the following characteristics can be found from the analysis of the cognitive map:

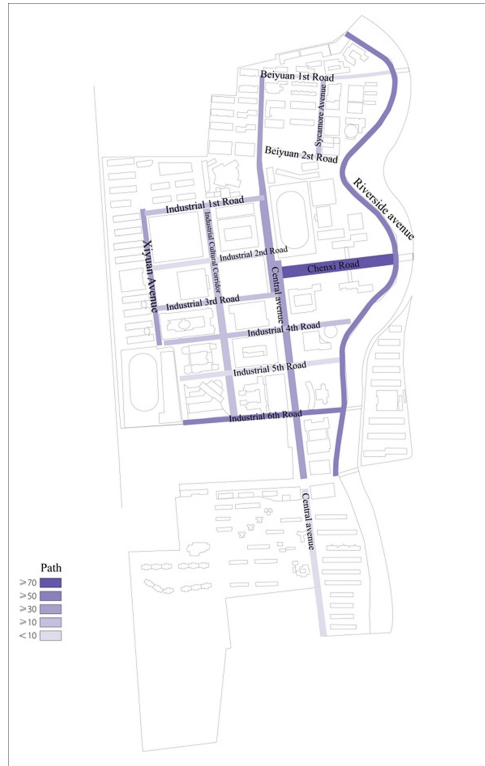


Fig. 5. Path Cognition Map Based on Mentions (Image source: drawn by the author)

- (1) Except for a few faculty members, the Southern District is an area that is almost ignored in the campus cognition of most student respondents. There are three reasons for this. First, because the current planning red line of the southern district was only delineated five years ago, and it is separated from other areas by urban roads (Wunan Road), there are independent entrances and exits, which psychologically creates the image of an “off-campus” area; The functional orientation of the district is mainly the living area of faculty and staff, which lacks necessary connections with the main body of students on campus; thirdly, as a living community, the southern district is more closely and openly connected with the surrounding environment of the city, and lacks the necessary elements of campus imagery. The “disappearance” of the southern district in the students’ cognitive image has the most direct impact on the perceived area of the campus. The campus area of the HBUT is more than 1,500 mu, and the area of the southern district accounts for more than 300 mu. It is concentrated in the other four districts, so the respondents reported that the campus of the HBUT is more crowded, and the long-term campus closure management since the new crown epidemic has made this contradiction even more prominent congestion happens all the time.

- (2) The east, north and west areas of the campus are generally recognized as areas, while the central area has a larger area and concentrates almost all-important teaching and research buildings, so image cognition is more microscopically focused on nodes, the central playground was mentioned most frequently as the area with the widest line of sight on the central axis.
- (3) Since there are dormitory areas in the other three districts except for the Central District, generally speaking, the students living in each district have a more detailed description of their own area, and the mutual understanding of each area is also different. As the only area east of the river, the East District has the clearest perception due to its very clear boundaries, but also because there is only one passage (East District Bridge), it forms an “isolated island” of the campus, and students who do not live in this district have weaker cognition. There are even students in other areas who do not know the existence of this area; the north area, the area with the longest history on campus, concentrates the only historical buildings on the campus and has the highest green area, and the image recognition of the area is strong; the west area is because of sports, catering, life Feature-rich is the most mentioned area (Fig. 6).

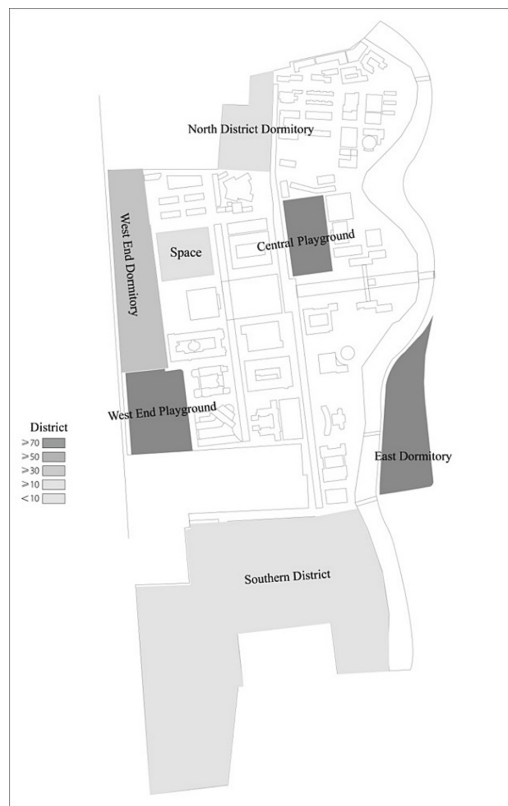


Fig. 6. District Cognition Map Based on Mentions (Image source: drawn by the author)

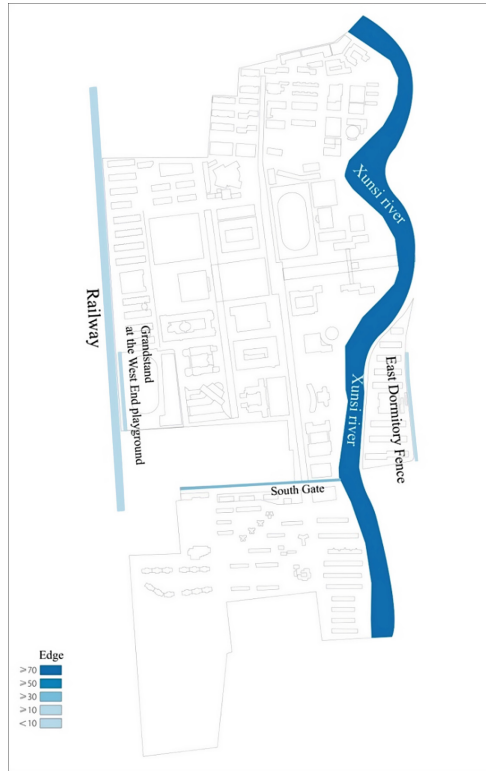


Fig. 7. Edge Cognition Map Based on Mentions (Image source: drawn by the author)

4.3 Edge

The edge of the HBUT is generally clear. Since the east side of the campus is built along the Beijing-Guangzhou railway line in the west, the boundary between the east and west of the campus is very clear and obvious, but from the frequency of mentions, the river boundary (88.6) is significantly higher than the railway (15.9), the reason is that on the one hand, several main entrances are located on the side of the river (west), while the railway is located in the deepest part (east), and on the other hand, the river as a campus landscape has a relatively “positive”, while the railway line is obscured due to its impact on life as a “negative” factor. Among the boundaries between the various areas, the east area is the only area located on the east side of the river, and the boundary between the river channel and the road wall is very obvious (Fig. 7).

4.4 Node

The nodes of the campus are point-like spaces that are cognitively attractive and able to gather, and some nodes can also transform the landmarks of the campus in spatial cognition. The nodes on the campus can be divided into buildings and landscapes. The most frequently mentioned buildings on the campus of the HBUT are the teaching and

research buildings in the central area along the central axis of the campus. Among them, the library has the highest mention rate among all elements (88.6). It can also be regarded as a landmark of the campus. The first floor of the teaching is also a landmark due to its important location (the first building on the central axis) and its long history, but the mentioned rate (79.5) is lower than that of the library. Among the five canteen building nodes, the “West District Life Plaza” (66.7) and the Central District Canteen (63.6) have the highest mention rates. In addition to catering, the two canteens have integrated a variety of other businesses to become the business district of the campus. Among the landscape nodes, the mentioned rate of squares of different scales in front of the library and the administrative building is relatively high, but it is worth noting that the mentioned rate of the square with an area of more than 20 mu in front of the library is not high (29.5), and it is not the small square (18.2) of the administrative building on the central axis is not much different. On the campus of the HBUT, the bridge is a special node. The four bridges are the only entrances and exits to the campus of the HBUT (except the east area). Therefore, the bridge is integrated with the school gate and road and becomes



Fig. 8. Node Cognition Map Based on Mentions (Image source: drawn by the author)

an important node, but the bridge itself has no characteristics, and it does not have the transformation characteristics of the marker (Fig. 8).

4.5 Landmark

In the analysis and extraction of the survey results, it is found that the buildings and landscape elements with landmark characteristics are mentioned less frequently on the campus of the HBUT. Among them, the top main gate arch and the highest library on the central axis are the most recognizable landmarks. The archway is the most important way-finding reference for entering the campus from outside the school, and the library is the most important way-finding reference in the school. The first floor of the teaching has been the landmark of the school since its completion (1984), but after the new library was completed (2016) landmark significance declined, and new buildings became the main landmark. Among other types of markers, the statue of Confucius in the administrative building square is the most mentioned among the landscape markers (34.1), and it is worth noting that the industrial culture corridor and the tour with the largest number of landscape nodes and sculptures built by the school in the past ten years are worth noting. In the Site landscape belt, the mentioned rate of its markers is generally below 10, which has not formed a strong image (Fig. 9).

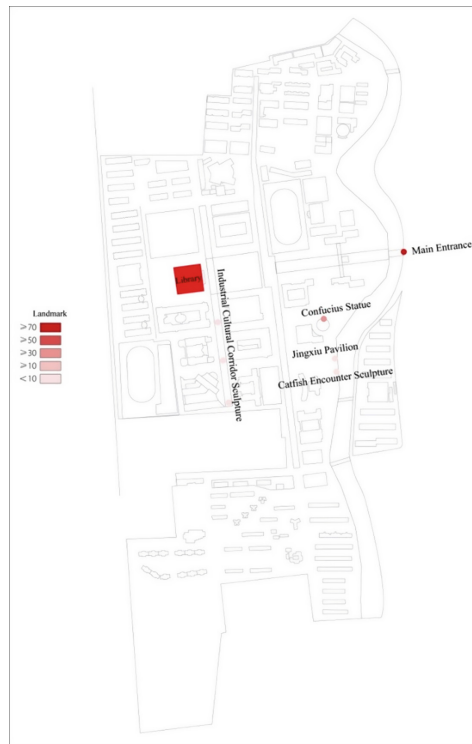


Fig. 9. Landmark Cognition Map Based on Mentions (Image source: drawn by the author)

5 Conclusions

According to the above analysis of the five elements of campus environment cognition and the information in the comprehensive questionnaires and interviews, the overall cognition of the campus of HBUT is presented as follows:

- (1) The mentioned rate of various elements of the campus gradually decreases along the two main axes of Chenxi Road and Zhongyang Avenue in the north and south directions. The imageability of various elements in the central area is significantly higher than that in other areas. The interviewer forgets, and the east area presents a bipolar tendency of the residents with clear cognitive image rather than the residents with little cognition.
- (2) Natural landscape elements are an important feature of the image of the campus of HBUT. Among all-natural elements, the Tounsi River has the most outstanding imageability, especially after the river management in recent years, the Tounsi River and the roads along the river. The landscape belt has a positive significance for the image of the campus. Due to the large green area and low buildings in the north area, the natural image is also more prominent.
- (3) Except along the river, the most mentioned elements on the campus are mainly to meet the needs of students in class, scientific research, and daily life. Most of the campus of the HBUT is relatively boring, although some campus cultural landscapes have been intensively created in the past five years, such as corridors, pavilions, sculptures, landscape stones, etc., but the imagery is not strong, and the campus still lacks an environmental space with a strong cultural atmosphere.

Acknowledgements. 2020 Open Fund of Hubei Design and Research Center of Cultural and Creative Industry “Research on experience design of campus public space under the background of COVID-19 Prevention and Control”.

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