Design Quality Evaluation of Campus Way-finding Based on SD Method

[1st] Mei Lyv*[1,a], [2nd] Jiaqi Tong[2,b], [3rd] Yumeng Meng[3,c]

{Lyvmei@sjzu.edu.cn[a], 1456642740@qq.com[b], yumengmeng@stu.sjzu.edu.cn[c]}

Associate Professor, Department of Design and Arts, Shenyang Jianzhu University, Shenyang, China[1]
Department of Design and Art University of Shenyang Jianzhu, Shenyang, China[2]
Graduate School of Environmental Engineering, The University of Kitakyushu, Fugang, Japen[3]

Abstract. In recent years more and more colleges and universities have opened their doors to the public, it has prompted universities to give increased attention to the development of the campus environment and infrastructure. The way-finding design of colleges and universities is also vital in which can guide visitors and new students, show the cultural heritage of colleges and universities. The design of functional composite way-finding has become a matter of urgency for every college. In this paper, firstly, field research on the current situation of the design of the way-finding of Shenyang Jianzhu University. Evaluating the spatial location, layout style and information content of a way-finding based on a Likert scale. Secondly, designing a way-finding experiment based on the spatial layout of the campus in terms of the way-finding behaviour of students, teachers and visitors. Evaluating the flow of the way-finding at Shenyang Jianzhu University and exploring the impact of the design of the way-finding on way-finding. Further propose the optimisation strategy of campus way-finding design. Provide theoretical and practical references for the future design of campus way-finding in grid format.

Keywords: Way-finding; Shenyang Jianzhu University; Way-finding behavior; Visual optimization

1 Introduction

With the improvement of the level of higher education in China, the group of teachers and students in colleges and universities is growing, and the number of undergraduate colleges and universities is increasing year by year, the campus environment of colleges and universities has become an important part of the urban development and urban spatial environment [1]. Well-known colleges and universities in various places are also used as tourist attractions for visitors, and as the internal environment of the campus is integrated with the external environment, there is an urgent need for a comfortable and smooth visit to the campus guided by a scientifically sound way-finding [2]. Campus way-finding is one of the important components of visual communication of university campus culture, student practice and eco-campus construction, it not only provides visitors with a smooth touring experience, but also serves to promote cultural exchanges, harmonize the campus environment and enhance students' sense of belonging to the campus. More importantly, it is an important carrier for

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spreading the culture of colleges and universities, and is one of the essential basic hardware facilities for the construction of college campuses [3].

The way-finding system guides people to find their way to their destinations in various spatial environments of the city, and way-finders use the way-finding information system of the built environment as a basis for their way-finding behavior [4]. Way-finding is a behavior that guides people to orientate themselves and find their destination through the physical environment and enhances their understanding and experience of space as an information system. Way-finding is not only about the way-finder's perceptions and decisions about the environment; it is also a system that encompasses multiple dimensions of behavior, design and operation. The theory of way-finding behavior is also gradually spreading from the field of psychology to the field of environmental design [5].

This paper analyses the relationship between way-finding, way-finding behavior and campus spatial form, and lays a theoretical foundation for the subsequent research on campus wayfinding based on way-finding behavior.

2 Research base

Shenyang Jianzhu University is located in Shenyang City, Liaoning Province, Hunnan New District, Hunnan Middle Road, is China's construction "new eight schools" one [6]; Shenyang Jianzhu University is a grid-like spatial form dominated by buildings, the horizontal and vertical axes of the buildings in the teaching area cross to form an 80M square space in the shape of an ogive, the overall spatial pattern is a typical net-type spatial structure. Compared with the road-based grid space form, the building-based grid space form is more complex in terms of internal space, and the difficulty of getting lost and finding one's way is more prominent, which puts more pressure on the design of the wayfinding. Therefore, this study chooses Shenyang Jianzhu University as the research base to analyse the current situation of its way-finding design in depth in order to solve its way-finding problems.

3 Research method

3.1 Questionnaire survey

According to the questionnaire question" your overall evaluation of the school wayfinding" the results show that 60% of the people on the Shenyang Architectural University wayfinding satisfaction deviation, The reason for the difference in satisfaction is explained: when first entering the campus, only 11.1% can complete the act of wayfinding without asking for directions at all, and only 37.78% can find the place they want to go through the existing design of the visual guide system;66.67% of people think that they are not clear about how to go in the wayfinding process many times. To sum up, the existing design of the visual guide system has affected people's use, and it is difficult to play the role of spatial instructions to guide people's daily learning and life.

In the indoor space, it is learnt through question 10 that the teaching building is the place where teachers and students get lost most often, followed by the promenade connected with

the teaching area (Fig. 4,3), which indicates that the design of the wayfinding in the teaching area is the worst area in the whole school, and 82.3% of the people don't understand how to go very well during the process of wayfinding guided by the existing design of the wayfinding, which indicates that the guidance signage is not sufficiently perfect in terms of the continuity of the guidance, the content and the basic functions such as recognizability. This shows that the guide signage in the guidance continuity, content and recognizability and other basic functions are not perfect. Outdoor space guide signs are mostly "promotional" signs that promote campus culture and introduce landscape vignettes; guide signs are not set up at important nodes such as the school's various bifurcation points and road sides, and the overall number of guide signs is far from being able to serve the campus space which is large in area and complex in spatial form, and it is difficult to support the teachers, students and visitors to find their way around in the campus in a smooth manner. It is difficult to support teachers, students and visitors to find their way around the campus smoothly.

3.2 Semantic Differential

This paper invites 100 students and teachers from different majors and grades to evaluate on-site the way-finding of Shenyang Jianzhu University. These evaluators included 10 faculty members and 90 undergraduate or graduate students in a variety of disciplines, including art, civil engineering, and architecture. The Richter scale was distributed to the evaluators, and 15 influencing factors were evaluated in three levels: information content, layout style and spatial position, when evaluating the influencing factors, the choice of adjective pairs is of great significance, the evaluation standard is 1-5 (Table 1).

In addition, before the evaluation, it is necessary to explain each influence feature and its adjective pair to the evaluators in order to obtain effective evaluation results. After inspection, 7 invalid questionnaires were rejected, and 93 valid questionnaires were finally harvested. Average the scoring results.

$$M = \frac{X_1 + \mathrm{X}_2 + \cdots + X_N}{N}$$

M represents the average value, X represents the scoring result of the examinee, 1, 2, 3 ... N represents the serial number of the examinee, and N represents the sum of the scores.

Table 1. Impact factor.

Impact factor category	Impact factor	Adjective pairs (5-1)
spatial location	Layout mode	Conformity to human visual habits - Not conformity
	Layout height	Reasonable - Unreasonable
	Layout spacing	Reasonable spacing - Unreasonable spacing
	Layout density	Reasonable density - Unreasonable density
	Layout environment	Unobstructed - Heavily obstructed
Layout style	Coherence	Compatible with the surrounding environment - Not compatible
	Eye-catching	Eye-catching signage information - Not eye-catching
	Normative	Design specification - Not specification
	Identity	Easy to recognize - Not easy to recognize

Information content	Artistic	Beautiful-Ugly
	Systemic	Integral - Independent
	Leads to continuity	Coherent - Disjointed
	Understandable	Easy to understand - Difficult to understand
	Scientific	Reasonable arrangement of contents and scale of signage - Unreasonable
	Appropriateness	Reasonable - Unreasonable

3.3 Way-finding Experiment

Before designing the experimental route, the author learned through distributing 200 valid questionnaires that the most common place for students to go in school is the science teaching and research area, among which 73.3% students go to the teaching building and 31.1% students go to the library. Secondly, the students' living area is the place they often go to. In the students' living area, 73.3% students go to commercial streets and dormitory buildings, 64.4% students go to canteens, and 62.2% students go to Supermarket. In the sports area, the playground, basketball court and sports hall are the places where students often engage in activities. Because Tieshi Square is close to the high-activity places such as the entrance to the long corridor, Jianda Supermarket, Commercial Street and canteen, Tieshi Square is the place with the highest utilization rate in the ecological leisure area.

Table 2. The road of way-finding experiment.

Serial number	Starting point	Ending point
Route A	North school gate	Campus paddy field
Route B	No.7 dormitory	Wu 1-307
Route C	Recreation and sports hall	school clinic
Route D	Landscape teaching and research section	Ding 2-203
Route E	Yi 5-403	Organ building

The total number of experimenters in this wayfinding experiment was 200, including 20 teachers; for the students, there were 100 new students in the first grade and 80 in the second grade and above. All subjects' familiarity with the school and the scope of their activities were in line with objective facts to ensure the objectivity as well as accuracy of the experimental results. The teacher group completed Streamline E, the second year and above students completed Streamline D, and the rest of the route was completed by the first-grader. (Table 2).

4 Research results

4.1 Semantic Differential results

4.1.1 Evaluation of spatial position of way-finding

By comparing the evaluation results of five influencing factors in spatial position between classes and within classes (Table 3). In the evaluation of spatial position, the layout mode is the highest value, which indicates that the layout mode selection is more reasonable in the spatial environment designed by the way-finding; The layout environment is the lowest value.

The layout spacing, layout height and layout mode are all higher than the average (2.94) in the intra-class comparison, which shows that the appraisers are basically satisfied with the layout spacing, layout height and layout mode of the existing way-finding (Figure 1).

Table 3. The results of space layout evaluation.

Layout mode	Layout height	Layout spacing	Layout density	Layout environment
3.4	3	3	2.7	2.6

The layout mode ranks first in the intra-class comparison and all 15 influencing factors, which shows that the selection of layout mode of signage signs is reasonable.

The average layout height ranks second in the space environment category and third among the 15 impact factor categories, which shows that people think that the layout height of signage signs is reasonable, but there are some problems in the layout of existing signage signs.

Layout environment refers to what kind of space environment the guiding signs are attached to. Both indoor and outdoor guiding signs should be arranged in a position with good lighting conditions and will not be blocked by crowds and other objects. The layout environment score is the lowest among the spatial environmental impact factors, which shows that people think that there are serious problems in the layout environment of the existing way-finding.

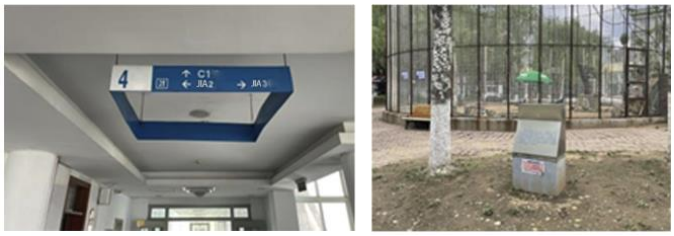

Figure 1. The spatial position of signage.

4.1.2 Evaluation of layout style of way-finding

By comparing the evaluation results of five influencing factors in the layout style between classes and within classes (Table 4). In the evaluation of layout style, the normative score is the highest and the artistic score is the lowest. The artistry and coordination are both lower than the average (2.52) in the intra-class comparison, which shows that the appraisers think that there is a great room for improvement in the artistry of the existing way-finding (Figure 2).

Figure 2. Layout style of way-finding.

There is also an unreasonable design of visual elements in Shenyang Jianzhu University's way-finding. People's rating of artistry is the worst factor in both intra-class comparison and inter-class comparison. Normative score is the highest, which shows that designers in the existing way-finding design in Shenyang Jianzhu University strictly follow the relevant industry standards and national standards, but ignore the artistic design of the signage logo.

Table 4. The results of layout style evaluation.

Normative	Identifying	Eye-catching	Coherence	Artistic
3.1	2.8	2.7	2.5	1.5

4.1.3 Evaluation of information content of the way-finding

By comparing the evaluation results of five influencing factors in the information content between classes and within classes (Table 5). In the evaluation of information content, the scientific score is the highest and the guidance continuity score is the lowest.

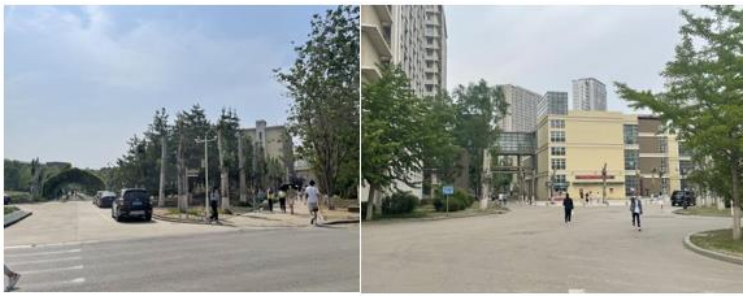

Figure 3. The Lack of information on signage.

The guidance continuity, scientificity and understandability are all lower than the average (2.6) in the intra-class comparison, indicating that the appraisers think that the information content design of the existing wayfinding is difficult to understand as a whole. Information continuity needs to be improved in some streamline lines; The scientific setting of guide information content is unreasonable; Therefore, there is a lack of functionality in guiding teachers, students and visitors to their destinations.

Table 5. The results of information content evaluation.

Scientific	Understandable	Systemic	Appropriateness	Leads to continuity
2.8	2.8	2.5	2.5	2.4

4.2 Experimental results of way-finding

The content or performance of way finding behavior can be explained and measured by four factors: ① speed of travel; ② number of backward steps; (3) number of stops and looks; ④ number of wrong turns [7]

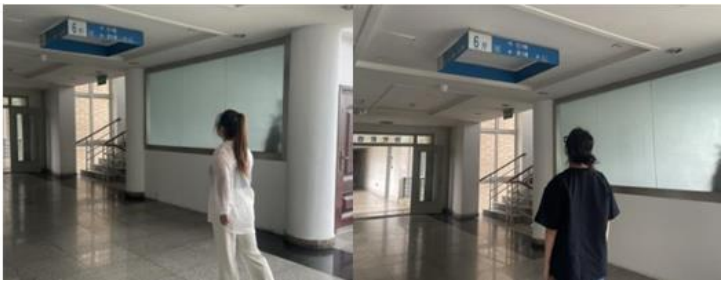

Figure 4. Way-finding experimental.

During the experiment, the above four data were recorded for each subject during the course of the experiment. After the experiment, the data for each route were calculated for each subject, resulting in four averages for each route, which were analyzed longitudinally for the five routes (Table 6). The traveling speeds of the experimenters in the five lines are 74m/min, 73m/min, 75.5m/min, 72m/min and 78m/min respectively.

Judging from the number of retreats, Line B has experienced six retreats, and B was completed by freshmen who just entered the school, which shows that it is difficult to complete the route finding by relying on the existing way-finding design when they are not familiar with the spatial environment of the teaching area. The experimenters of Streamlines A and C are freshmen, and they have retreated four times in the process of finding their way, which shows that it is difficult for the guide signs within the streamline to further guide people to the next node, and it also proves that the problem of nodes in the outdoor streamline of campus is more serious. Streamline D is a student above the second year of undergraduate course. Although Streamline D has some memory of the space environment of the teaching building and the distribution of guiding signs, Streamline D still has three retreats in finding the destination. Because the experimenters of Streamline E were a teacher who is familiar with this route for the office building of the campus "service center" that they often go to, so there is no retreat.

According to the data of the number of times the experimenters stopped and watched, the number of times the streamline B was the most, with 20 times. Followed by streamline A and streamline D for 16 times and 12 times respectively. After field investigation, it is known that these two lines involve multiple intersections, and the spatial structure of the two streamline lines is not complicated. However, because there is no guide sign as a guide, people can only confirm their position through surrounding buildings such as dormitories and canteens in the process of finding their way. However, because the surrounding areas of streamline C are mostly open places such as basketball courts and playgrounds, it is more difficult for people to find reference objects, so the phenomenon of wrong turn has taken place.

Table 6. The results of way-finding in 5 roads.

Route	Speed/minute (metres)	Number of backs	Number of stops and looks	Number of wrong turns
A	74	4	16	0
B	73	6	20	2
C	75.5	4	10	2

D	72	3	12	0
E	78	0	6	0

5 The optimization strategy

Standardize the design elements of the way-finding. The unification of the visual elements of the way-finding is one of the simplest means and methods to realize the design consistency of the way-finding. The text, graphic symbols and colors of the indoor and outdoor space environment in the way-finding design of Shenyang Jianzhu University are planned and designed in a unified way, so as to promote teachers, students and visitors to form a unified cognition and interpretation of the way-finding design of Shenyang Jianzhu University.

Humanized design. The design of way-finding not only needs to ensure its artistry, but also needs to consider the functionality from the perspective of humanization and the psychological activities of pathfinders when they get lost [8]. Therefore, the design of guide form needs to comprehensively consider characters, graphic symbols and languages, and consider the individual factors of different users from the perspective of humanization, that is, consider the details of way-finding design for different ages, different cognitive abilities and different regions, so as to improve the effective use of way-finding design and reflect the care for various groups.

Increase the layout density of signage signs, when pathfinders are in places where the layout of signage signs is relatively concentrated, they will feel that the design of way-finding in these places is more mature. However, sometimes placing too many signage signs in the space will cause some interference, and it is difficult to find the signage space information you want to obtain.

Adjust the layout height of signage signs. The layout height of signage signs in Shenyang Jianzhu University mainly focuses on the top space signage signs in the square hall of the teaching area. The original intention of this location is to avoid the inconvenience of obtaining signage information due to the large flow of people, but it solves the problem of crowd occlusion, but the layout of signage signs does not conform to the surrounding environment. Therefore, it is necessary to adjust the height of the signage signs and reduce the height of the signage signs to a suitable height.

6 Conclusions

Colleges and universities, with a strong humanistic color and academic atmosphere, are the main positions leading cultural development [9], which are different from other public space places. With the development trend of "scenic spots" in colleges and universities, it has brought a lot of challenges to the infrastructure construction of colleges and universities. As the most important part of campus infrastructure construction, the design of university way-finding has gradually become one of the important research directions of way-finding.

In addition, with the continuous expansion of the space scale of colleges and universities, because of its increasingly complex space environment and environment [10], finding the way on the campus of colleges and universities has aroused the interest of many researchers. The

design of way-finding is dependent on the campus space form to guide teachers, students and tourists to complete the road-finding behavior, and the design of way-finding under different space forms should also be different. Among them, the campus environment of colleges and universities with network format is the most complicated, and the design of guiding system is very important in this complex environment, which can improve the study and life of teachers and students on campus. It is of great significance for tourists to visit the campus and increase the communication between the school and the society.

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