Research on University Participatory Landscape Environmental Behavior Patterns

Jin Xia(✉) and Yu-Meng Xie

School of Design Art, Xiamen University of Technology, Jimei, Xiamen, Fujian, China
236859746@qq.com

Abstract. By analyzing the environmental behavior of green spaces between the academic buildings of Xiamen University of Technology, this study finds problems in the university landscape environment including unclear spatial function, incomplete recreational facilities, low spatial utilization, lack of interaction space, and haphazard plant arrangement. In view of these problems, it proposes a participatory landscape design method, so that teachers and students can participate in design of the university landscape environment, and the landscape can provide a public space for communication, study and leisure for teachers and students, enhancing their sense of identity and belonging. It adopts the methods of literature research, questionnaires, behavioral observation and interviews in order to provide effective solutions for the problems of insufficient utilization of university landscape space and lack of user participation. In the end, the feasibility of this study is demonstrated by preliminary investigation and analysis of environmental behavior, application of participatory landscape design theory and method, and practice of actual site design, providing some ideas for participatory landscape design.

Keywords: Environmental behavior · participatory design · university landscape

1 Introduction

Traditional university landscape design was often based on factors such as campus culture, human history, and characteristics of the spatial environment. The designers were usually associated design workers or leaders, who made project decisions in a traditional top-down design mode [1], while tending to ignore the impact of spatial environment on crowd behavior patterns and user demand for spatial functions. Many university campus landscape problems still exist, including weak landscape spatial function, weak interaction between the space and its users, insufficient public interaction space for campus personnel, and a lack of features [2]. Participatory landscape design, in contrast, attaches importance to human behavior and needs in the spatial environment, and emphasizes direct user participation in the design in order to form an interactive relationship between users and the environment. In particular, during the current pandemic and post-pandemic period, in order to reduce covid transmission, teachers and students mainly focus on campus activities, so they increasingly demand spaces that can adjust their mood, and be used for study, communication and leisure.

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University landscape is crucial as part of the campus culture in cultivating students' learning ability, disseminating knowledge, and shaping values. It also plays a positive role in students' development. Using the green space between the academic buildings of Xiamen University of Technology as an example, this study explores the participatory university landscape design method through investigation of the environmental behavior patterns of university teachers and students. It analyzes the influence of the environment on their behavior patterns, summarizes existing problems, and uses the participatory landscape design method on the basis of meeting their spatial needs to design an interactive space where teachers and students can communicate, stay alone, or participate in leisure activities. The study is based on university participatory landscape design and has certain enlightening significance. It also sets a good example for other designers when updating their university design concept, helping achieve innovative university landscape design.

2 Literature Review

2.1 Characteristics of University Environmental Behavior Patterns

The behavior pattern of the university campus environment is specialized and private. People tend to make the space into their own, while privacy is a kind of control over the distance range of others approaching themselves [3]. Based on people's specialization and privacy features, it is important to pay attention to different spatial characteristics in environmental designs such as public, semi-public, private, and semi-private spaces. It is possible to use multi-level collocations of plants, placement of seats, and different distances to design comfortable functional spaces for teachers and students. Moreover, according to the "boundary effect" developed by the psychologist Derk de Jonge, people prefer to stay at the edge of two adjacent spaces. The reason is that they can observe others while keeping a distance with them at the boundary [3]. It is also important to pay attention to the boundary effect in the university landscape design. For example, facilities can be set up for people to stay in boundary areas, not only helping improve the possibility of communication and interaction between teachers and students, but also showing humanistic care in the design.

The study of university environmental behavior patterns is significant to university landscape design. The campus environment is the main space for teachers and students to live, communicate, and learn on a daily basis, and it subtly affects the daily behavior and activities of teachers and students. Analysis of research on university environmental behavior patterns can prevent university environmental design from overemphasizing formal beauty while neglecting users' physical and psychological needs, helping create a truly comfortable environment for teacher and student.

2.2 Research of University Participatory Landscape Design

University participatory landscape design means applying the concept of participatory design to university environmental design. Participatory landscape means connecting landscapes with people to generate psychological or behavioral interaction, enabling

people to participate in construction of their environment, achieving emotional resonance between them and the landscape, and giving people a sense of identity and belonging in the space [4]. The main objects of university participatory landscape design are teachers and students on campus. First, design majors and their instructors participated in campus landscape construction, putting their own professional learning to use. Furthermore, non-design teachers and students, who account for the majority of users, also participated in the design process guided, by the theory of public participation [5]. Study of their use behavior, problems, and needs, improved their voice and sense of participation, and interaction with the spatial landscape was generated by guiding teachers and students through participatory design to promote communication and mood blending among people.

International research on university participatory landscape design is currently in the developmental stage. In his article "Research on Participatory Campus Landscape Design Based on College Students' Behavioral Patterns", Li Simiao (2018) mentioned "five principles of participatory campus landscape innovation design: humanization, education, social promotion, diverse teaching environment, and mood resonance" [4]. The general design principle in participatory campus landscape design is people orientation, with diverse interactive designs based on the spatial needs of teachers and students. In summary, the spatial needs of teachers and students should not be ignored in university participatory design. The principles of participatory design should be followed, and the design should solve problems according to the actual situation, without mechanical application. In 2020, Li Ruolan studied international university participatory landscape design, with great theoretical insights. Li also connected landscapes with users, and considered and analyzed them from the perspective of humanistic care [6]. Generally speaking, in international campus landscape design, most universities still only apply the traditional passive landscape participation among people and between people and nature, and most campuses do not apply participatory landscape design. It is important to utilize the richness of campus participatory landscape design theory, adhere to the people-oriented design concept, and combine with the actual situation of the design environment, to create reasonable campus designs for interaction between people and the landscape.

3 Research Design

3.1 Analysis of Case Background

3.1.1 Background Analysis of the Space

This paper takes the green space between the academic buildings of Xiamen University of Technology as a case study. The green space is located between Mingli academic buildings 1–2 and 5–6 of Xiamen University of Technology in Jimei District, Xiamen, Fujian, China. The green space between buildings 1–2 is located on their ground floors. To the north of the space, there is a parking lot, and to the south is a supermarket. To the west, the space is connected with the main road on campus, and to the east with the stairs on the first floor of the academic building (Fig. 1). The green space between buildings 5–6 of Mingli Building is also on their ground floors. To the north, the space

is connected with Building 4, and to the south, Building 6. The west faces the practice laboratory of the university, and to the east is Building 5 (Fig. 2). There are academic buildings, a beverage shop and laboratories nearby. As a passageway between several teaching buildings, there is only one path through the site. The lab is only open during fixed hours, so lab noise has less impact on the site. The beverage store is a building away from the base, so there is basically no noise. The base maintains a relatively quiet environment except when students go to and from school.

There are bicycles and sightseeing buses on campus. General transportation can not direct base 1–2, you need to walk in the gate of Mingli Garden. It takes about 3 min to walk from the gate of Mingli Building to Base 1, about 500 m. It takes about 6 min to walk 900 m from the gate of Mingli Building to Base 2. There are bicycles and sightseeing buses on campus. General transportation can not direct base 1–2, you need to walk in the gate of Mingli Garden. It takes about 3 min to walk from the gate of Mingli Building to Base 1, about 500 m. It takes about 6 min to walk 900 m from the gate of Mingli Building to Base 2.

The supermarket in the south of Base 1 is the largest supermarket in the school, where bread, food and daily necessities are sold. Therefore, many passing students choose to buy breakfast and lunch in the supermarket, and students also like to go shopping in groups after class. The important buildings around the site can be found through the guide plates and instructions in the design.

The focus of the study is to make the space design participatory, so that the campus landscape can be seen.

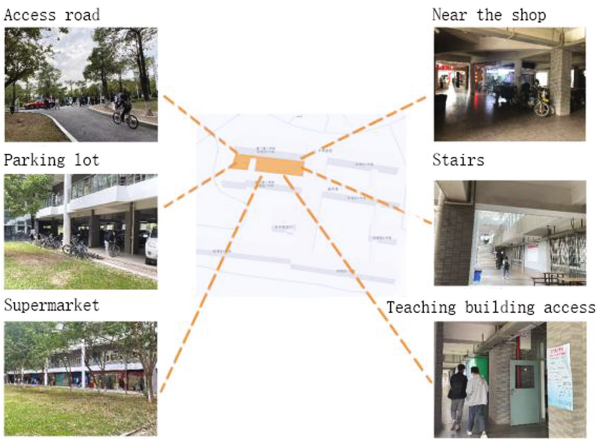


Fig. 1. Environment surrounding the green space between Mingli buildings 1–2.

Fig. 2. Environment surrounding the green space between Mingli buildings 5–6

3.1.2 Analysis of Users

The main groups between buildings 1 and 2 are students, faculty and shop staff. The peak hours are 7:00–8:00 am, and 12:00–13:00. Students go to school, leave classrooms, and have meals during those times. This space is one of the main paths for students to and from classrooms. At the same time, the supermarket has windows for light meals, which further increases the student traffic. Moreover, the major groups between Mingli buildings 5 and 6 are students and faculty. Similarly, there are more people in the morning and at noon, but less than between buildings 1 and 2.

3.1.3 Analysis of Participating Designers

This study was carried out in conjunction with the course "Landscape Design I" for environmental design majors in the School of Design Art, Xiamen University of Technology. After learning landscape design theory, environmental design majors implemented the campus participatory landscape design practice project organized by their instructors. The class consisted of 33 students, and was divided into design teams of four to five students. It took five weeks for the students to complete basic research and plan design. Each team selected a patch of green space on the campus for in-depth research and participatory design. In the design process, based on the participatory design theory that the users are the designers, the teams asked users to participate in the design process, received feedback according to their use, adopted their feasible ideas and demands, and constantly communicated with the instructor to further improve the design plan.

3.2 Research Methods

3.2.1 Literature Research

This study collected data about environmental behavior, university landscape construction and participatory design via resources such as the library and the internet, and

selected high quality and relevant theoretical and practical information for logical text sorting, analysis and summary. Literature related to the current situation of the space between Mingli Academic Buildings 1–2 and 5–6 was searched using the keywords "university landscape design" and "participatory design" to find materials and literature related to the similar issues. Solutions and strategies regarding problems such as lack of communication places, poor participation and unclear space functionality were summarized, for example improving the green spatial environment, getting close to the campus landscape, adding functional facilities for study and leisure, setting up interactive equipment, and using the color, smell, and texture of plants to mobilize the experience of the five senses to guide people's behavior and moods during use to create a touching environment to foster new thinking.

3.2.2 Questionnaires

This study used an online questionnaire to investigate the traffic and peak times of the green space between academic buildings, usage of the space, functional requirements of the campus landscape, and understanding of the participatory concept to learn why teachers and students pass through the space, and analyze its existing spatial functions. The questionnaire also asked students and teachers about their spatial function preference and demands, and collect their opinions on renovation of the space, laying a foundation for subsequent design direction and spatial function design. Its structure was based on the principles of sound methodology, simplicity, and short completion time, and it was reasonably distributed using a QR code. The main targets of the questionnaire were students of Xiamen University of Technology. Distributed through social media and offline QR code scanning, 42 valid questionnaires were collected. Finally, the results of the questionnaire were analyzed, and data were summarized. The questionnaire can enhance the sense of participation of users in environmental design, and measure their feasible opinions on participatory design.

3.2.3 Behavioral Observation

This study observed the users and environment of the space in order to understand its use status, and observed, recorded and summarized user behavior and existing problems (Table 1). It observed behaviors and paths in the rebuilt on-campus space at different times and in different places. It also took picture records, and summarized the data to understand functions and paths. Users rest in the space between academic buildings nos. 1–2 for a shorter period of time, because the original space has fewer functions, lacking a purpose to stay. Due to the single, narrow road, the supermarket entrance is crowded, and users are blocked. A large number of people often wait in front of the shop, blocking the passage and resulting in a crowded road, which shows a need for a waiting space. The dining space is small. After buying food, users have no seats to sit in due to the large number of people eating, so they can only look for other spaces. This reflects the problems that the dining space has few tables and chairs, and the environment is too dark. Furthermore, due to the lack of waiting and dining space, users tend to stand on the lawn by the road for a long time, so the lawn cannot grow well, resulting in bare soil.

Table 1. Behavior and spatial problems in different time periods

Space	Observation time	Picture	Crowd behavior	Spatial problems
Mingli academic buildings nos. 1-2	7:00-8:20		Walking, riding, buying food, eating and drinking;	1. Large traffic, crowded roads. 2. Lack of space for waiting and dining. 3. Single function, with few facilities. 4. Dark rest space; poor environment.
	12:00-13:00		Walking, riding, buying food, eating, drinking, waiting, and talking;	
	16:00-17:00		Walking, riding, buying food, lingering, resting, eating, drinking, talking, waiting, playing on phones;	
Mingli academic buildings Nos. 5-6	7:00-8:20		Walking, passing through, looking around;	1. Lack of basic public facilities, and inability to meet users' needs.
	12:00-13:00		walking, staying, talking, resting, studying, eating and drinking, looking around;	2. Lack of lighting system at night, with safety hazards when walking by. 3.Haphazard plant design, lacking sense of beauty. 4. Single function; people only linger for a short time.
	16:00-17:00		walking, waiting, talking, eating and drinking;	

In the space between academic buildings nos. 5–6, there is only one road, lacking basic public facilities. There are no places for people to rest or any hard ground, so teachers and students cannot stay and carry out activities there for a long time. At night, few people pass by. A small number of people use mobile phone flashlights for lighting,

which shows a lack of lighting facilities, causing security concerns. People often carry garbage when passing by, or just throw garbage in the space at will, reflecting a lack of basic facilities in the space and its surroundings. In addition, the plants around the space are haphazard, lacking aesthetic sense. Teachers and students only pass by when they go to class, so the utilization rate is low.

3.2.4 Interview Methods

The study used situational and structural interviews. In the situational interviews, researchers interviewed and communicated with the subjects based on the spatial design or the place where their behaviors take place, based on the actual scenarios and spaces, so that during the interview, interviewees could describe their problems or spatial needs in a more detailed, concrete and intuitive way. Random interviews were conducted with teachers and students, as well as nearby staff passing by the spaces, so as to obtain broader information. In the structural interviews, questions were designed, the interview content clarified, and information needed by the researcher was collected in advance for more effective interviews. Questions related to participatory campus landscape design were added, asking about current design issues and functional requirements. The interviews clarified that teachers and students in the university have requirements for resting, residing, and communicating (Table 2). In the later design stage, actual user requirements will be consciously added to create a comfortable space more in line with user needs.

Table 2. Summary of Interviewees and Their Requirements

No.	Interviewee	Requirements
1.	Sophomore, English major	Space for morning reading and study
2.	Junior, Design major	Better spatial utilization rate, more space for communication
3.	Sophomore, Economics major	Space for leisure and club activities
4.	Teacher of logistics management	Space for dining and communication, better basic facilities
5.	Freshman, English major	Waiting space near the supermarket, better dining space environment
6.	Sophomore, Financial Management	The landscape should reflect the campus atmosphere
7.	Junior, Art major	More space for dining, spatial optimization for leisure
8.	Teacher of environmental engineering	Spatial optimization for leisure and campus environment; signs and decorations
9.	Sophomore, E-commerce major	Space for entertainment, interaction, communication, and leisure

4 Analysis of Results

In accordance with the principle of respecting the original spatial environment, this study comprehensively investigated the green space resources outside the academic buildings in Xiamen University of Technology. Starting from the original configuration of plants and traffic, and existing problems, advantages and needs, it analyzed the parts of the space to be kept and abandoned. Starting from fields including the humanities, sociology, and psychology, it focused on time, space, and people to connect function and place.

4.1 Questionnaire Results

In order to fully understand the needs of teachers and students for campus green space function and the current use situation, in the university participatory landscape design process, teachers and students and nearby staff conducted a questionnaire survey "on green space usage requirements and current behavior," with 42 effective participants. Refer to Table 3 for the results.

The questionnaire showed that 78.57% of teachers and students only pass through the base to go to class, which reflects its weak functionality and low utilization. For the preferred alternative focuses of landscape construction, 64.29% of the teachers and students choose functional landscapes in order to increase the utilization. Teachers and students hope to add functional space for discussion and rest, while other staff members

Table 3. Result of the questionnaire "On the use demand of green space and current use behavior"

Question	Item	Number of people	Percentage
1. Reasons for passing by the space	Go to class	33	78.57%
	Study	19	45.24%
	Go to the store	11	26.19%
	Others	8	19.05%
2. Preferred focus of landscape construction	Ornamental value (plants)	15	35.71%
	Functional value (enforceable action)	27	64.29%
3. Functions that can be added	Study	8	19.04%
	Discussion	10	23.8%
	Rest	24	57.14%
4. Renovation advice (multiple choice)	Shared planting room (semi-open space)	29	69.04%
	Landscape pavilion	19	45.23%
	More basic facilities (garbage cans, lighting)	19	45.23%
	Functional construction (for study, rest, or discussion)	30	71.42%

hope to add space for rest after work, accounting for 57.14% of the total. For renovation suggestions, most teachers and students selected design of the interactive space, including shared planting and more basic facilities, showing their needs for interpersonal interaction and connection functions.

Therefore, according to the above summary research of campus user questionnaire, the participatory landscape design method of campus is used to allow teachers and students to participate in the environmental design, so as to provide a space more in line with the needs of campus users, so that teachers and students can have a sense of identity and belonging to the campus.

4.2 Classification, Recording and Analysis of Spatial Data

4.2.1 The Green Space Between Mingli Academic Building Nos. 1–2

1. Problem analysis: The design team investigated and analyzed the current situation of green space between Mingli academic buildings no. 1–2, and found the following problems: 1) For walking and riding, there is large traffic, and the passage is crowded; 2) For discussion and rest, the function of the space is undiversified due to the low utilization of the green landscape, so there is a lack of environmental facilities for communication and rest; 3) For eating and drinking, the tables and chairs are quite sparse, with dim lighting, and garbage is discarded at will; 4) There is no space for temporary waiting or seats for leisure.
2. Behavioral analysis: It is mostly students and teachers passing between Mingli academic buildings nos. 1–2. In the south, there are spaces including a supermarket, food vendors, a bank, a print shop, and stationery shop, surrounded by the academic buildings. Thus, students and teachers come here between classes to buy meals and daily necessities – behaviors closely related to the space. Since there are no basic paths designed on the green space, few cross or walk on the lawn, leading to low utilization. After buying food, teachers and students sit in the dining area next to the space. After the meal, they leave quickly, lingering for only a short period with little communication. After school, students wait for their friends in front of the supermarket. Since the road is narrow, they often need to walk around to avoid pedestrians. Some students rest against the pillars in the corridor.
3. User requirements: Through the questionnaires, interviews and the concept of participatory campus landscape, it can be concluded that users of the space between academic buildings nos. 1–2 need space for rest, dining, interaction, communication, and waiting. Therefore, places for lingering, waiting, and rest should be added in the landscape design in order to create a nice and clean dining atmosphere, expand the traffic in the space, and reduce crowding.

4.2.2 The Green Space Between Mingli Academic Buildings Nos. 5–6

1. Problem analysis: The design team conducted several field visits to analyze the space, and found the following problems and designed relevant solutions. 1) There is only one intersection; more roads should be added according to the traffic and environmental psychology of the short-cut effect; 2) There should be a barrier between the

bathroom and the outside to isolate the odor and increase the privacy; 3) A barrier should be set at the back of the space to block the northeast wind, while still not affecting users' view into the distance; 4) The space lacks artificial lighting facilities and garbage cans, which should be added according to traffic and functionality. 5) Small landscape spots should be added according to the sight line analysis of the landscape in the main sight focus points.

2. Behavioral analysis: Most of the people passing through the space between Mingli academic buildings nos. 5–6 are teachers and students, so the traffic is light. Since many trees are planted in the green space, users generally pass through the space by taking the only road in it. Because the main entrance is not obvious, based on the shortcut effect, most students take the small path in the lawn connecting to the main road, while only a small number rest in the quiet environment alone, enjoying the solitude, relaxing, or reading. Moreover, there are five sets of tables and chairs at the side of the model making room, where some students eat, read and wait in their spare time.
3. User requirements: Since the functions of the space between Mingli academic buildings nos. 5–6 is unclear, teachers and students hope that the functions of communicating, studying, resting and dining can be added. University cleaning staff also need more space for rest after work. Therefore, users hope to create a participatory, ornamental and practical space.

4.3 Summary

Objective investigation and analysis of the campus space at early stage clarified the problems that need to be solved and users' requirements for the space. By analyzing the crowd behavior in the space, hidden problems were deduced, and the requirements have been verified.

Based on the problems and user requirements, the functions of the space between academic buildings nos. 1–2 will be planned, and the landscape improved, including improvement and addition of dining space, addition of waiting and leisure facilities, addition of creative and interactive facilities, provision of communication space, improvement of the lighting system, and campus cultural landscaping. The main problem between academic buildings nos. 5–6 is the weak function. In order to enhance its spatial function, it is necessary to add dining space, create semi-private learning space and facilities for communication and interaction, and implement campus cultural landscape design.

Based on preliminary data analysis and summary, this study communicated with the instructors about several design plans, aiming to shorten the distance among people, and between people and nature, and create resonance in the soul – that is, paying attention to interaction, participation and usage requirements, turning users into designers. Collaborative orientation and iteration are the observed aspects of the participation processes, and also reflect collective understanding, development and mutual learning [7]. During communication of the plan, it is necessary to promptly spot problems, modify the plans, and communicate actively. While understanding the needs of users, it is also important to feed back our design ideas so as to understand and learn from each other, making the design plan promotion more efficient, with an increased the sense of participation among users.

5 Exploring Participatory Landscape Design Practices

5.1 Analysis of Participatory Design Method

5.1.1 Design Method for Themed Participatory Campus Landscapes

Themed participatory campus landscapes means setting a unique theme for the university landscape. The theme can be either abstract or concrete [3]. The themes of the two spaces between the Mingli academic buildings were determined based on the themed participatory campus landscape design methods. We proposed the abstract design theme of "resonance" according to the concepts of participatory campus landscapes. After the theme was determined, we investigated and analyzed the target group – teachers, students and staff of Xiamen University of Technology – and concluded that the target group liked the creative space with leisure characteristics so that people can interact in it. Ulrich suggested that when natural stimuli are not threatening, people naturally tend to find them calming, and exposure to these stimuli can multiply their sense of happiness and relaxation [8]. The design of the green space between academic buildings nos. 1–2 used for relieving pressure not only can be used as interactive space, as requested by the target users, but also to enable the target users to connect with nature and get natural stimulation without threat, so as to relieve pressure and achieve resonance between people and nature.

5.1.2 Design Method for Practical Participatory Campus Landscape

Practical participatory campus landscape design methods mean to carry out practical landscape activities in the university. In order to design the planting area between academic buildings nos. 5–6, for example, we adopted the method of practical participatory campus landscape design. The functional design of planting and raising plants helped students to participate in the space. Planting can have a certain healing effect, allowing students to feel the process of cultivating life. We used design to connect space and people and generate memories in order to achieve participation in the landscape.

5.1.3 Design Method for Displaying Participatory Campus Landscape

A "display" participatory campus means providing a university platform for students to show themselves [3]. The activity lawn we designed in the space between academic buildings nos. 5–6 provides a space for students to freely show their talents, such as instrumental performances or hip-hop dances. As long as there is a show, there will be audience. People will be connected without noticing, increasing the sense of interaction with the landscape, enriching students' spare time and enhancing their confidence.

5.2 The Green Space Design Plan Between the Academic Buildings of Xiamen University of Technology with Participation by Teachers and Students

In this stage, based on the previous questionnaire and spatial environment analysis, the design team came up with the following design plan after discussion and continuous update.

5.2.1 The Space Between Mingli Academic Buildings Nos. 1–2

Based on the concept of campus participatory design, this study puts forward the design concepts of orientation towards people, satisfying emotional needs, paying attention to people's experience and feelings, conforming to sustainable development, respecting the campus environment, and following ecological design. Based on this, according to the characteristics of the spatial environment, we first solved the pain points of the space. The functional division of the space should be graphically studied, and the rest area should be appropriately increased, providing space for people to communicate and wait. Next, based on the analysis of traffic in the space and the psychological shortcut effect, the roads next to the space should be adjusted to increase convenience, reduce crowding, and improve the transit efficiency. Finally, the original plants should be kept, and Xiamen local plants should be added to improve the space, creating space for interaction between people and nature. Add a good environment for dining space, for students to increase the convenience of dining.

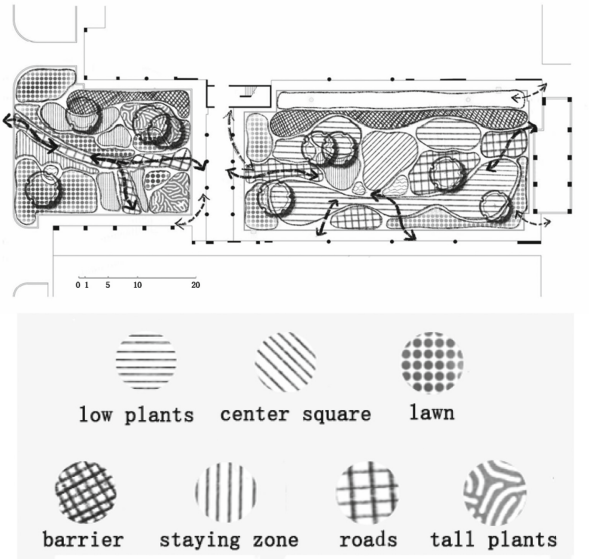


Fig. 3. Graphical study of functional divisions in the space between buildings nos. 1–2

The spatial functions (Fig. 4) are divided based on the functional graph (Fig. 3). Based on the concepts of university participatory landscape design and environmental behavior analysis, a landscape walkway should be added, solving the problem of the narrow and crowded single path, and also enabling people to experience the characteristics of the campus landscape, in order to interact with the landscape (Fig. 5). A lawn for activity and fitness equipment area should be designed at the edge, providing space for waiting and leisure for teachers and students (Fig. 6). At the same time, a space should be designed for relieving pressure, providing a space for interaction and communication between teachers and students to enhance their sense of participation in the space.

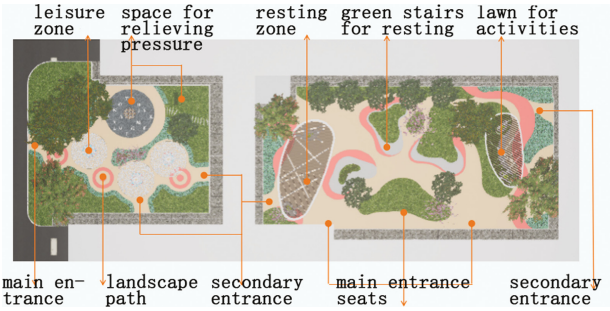


Fig. 4. Function divisional map of the space between buildings nos. 1–2

Fig. 5. Aerial view

Fig. 6. View of the leisure zone

5.2.2 The Space Between Mingli Academic Buildings Nos. 5–6

This study aims to create a comfortable campus environment through landscape design, and also improve the value of the space. The design theme of "let education take place in the natural university landscape" should be seized, and we should use the design to connect people, and people with nature, creating a participatory campus space. Social environmental practice aims for rational utilization of resources and environmental protection. It is a set of interacting elements, personifying the interaction process between

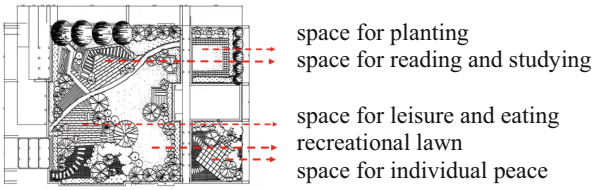
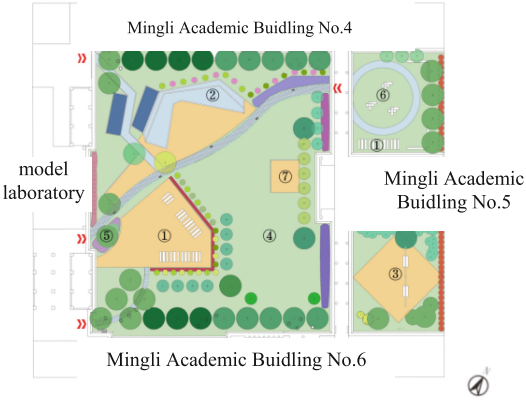


Fig. 7. Function divisional graphical study of the space between buildings nos. 5–6

people and the surrounding natural environment. [9] Therefore, the design and reconstruction practice of campus social environment should focus on increasing the utilization of environmental resources, creating an interactive spatial environment while protecting the environment. Basic facilities should be added to solve the problem of lack of space for rest. We should also provide participatory facilities, and set up attractive interactive scenes to shorten the distance between people and nature.

In order to increase the utilization of space and meet the spatial needs of teachers and students, the space should be divided after considering its characteristics according to the function division graphical study (Fig. 7) into several functional areas including spaces for rest and dining, activity, study, quiet space, and landscape area.

In order to further deepen the space and divide its functions (Fig. 8), based on the analysis of environmental behavior and the concept of participatory university landscape



①space for leisure and eating
②space for reading and studying
③space for individual peace
④lawn for activities
⑤landscape for display
⑥space for planting
⑦space for resting

Fig. 8. Function divisional map of the space between buildings nos. 5–6

Fig. 9. View of the rest area

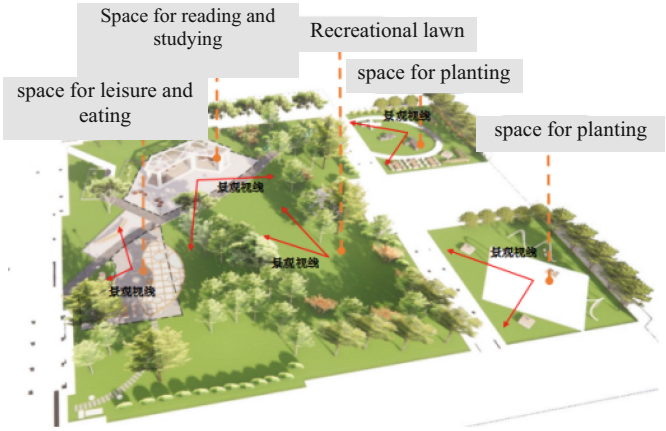


Fig. 10. Aerial view

design, spaces are designed such as a space for leisure (Fig. 9), a lawn for activity, and a space for personal recreation. A semi-closed individual quiet space is also designed considering the spatial features, providing students and teachers with a good environment for leisure and meditation. Participatory ecological methods should be adopted, so that users can focus on identifying, acquiring and using skills in the environment, and understand the relationship between the environment and themselves [10]. A free lawn for activity is designed, allowing people to communicate and get to know each other, not only shortening the distance between people, but also increasing their sense of connection with the environment. A planting space is designed to deepen the spatial function, increasing people's sense of interaction and participation in the landscape to achieve integration between people and the landscape, and resonance between people and nature (Fig. 10). Additional activity space, for students to carry out outdoor activities to provide convenience.

6 Conclusion

Through the landscape design practices of the green spaces between academic buildings in Xiamen University of Technology, we discovered common campus landscape problems, and used participatory landscape design and an analysis of environmental behavior patterns to provide suggestions to improve the campus landscape design. The participatory design method in this study has led to important conclusions, including:

(1) Participatory design. We should implement the people-oriented design concept, and pay attention to users' real needs, enable them to participate in the design, and design space from their perspective.
(2) Spatial design. It is necessary to analyze crowd behavior patterns. By focusing on users' behavior in the design space, we can infer spatial needs of which the users themselves are unaware, so as to make the design more humanized.
(3) Campus landscape design. We should pay more attention to spatial functionality and interaction, and use design to connect people, and people with the environment, so as to create a participatory campus space, making a sense of resonance between the campus, teachers and students.

In conclusion, this study has analyzed and applied the university participatory landscape design method based on environmental behavior patterns, and found effective and implementable participatory landscape design methods according to research and practice. It is hoped that this case study can provide reference value for future campus participatory landscape design.

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References

1. Cao, L., Shen, Y., Wang.Y. (2019) Concepts and practical exploration of participatory campus landscape planning and design, Journal of Tianjin University, 21 (4): 339–346
2. Yang, S.C. (2015) Research on Participatory Landscape Design of University Campus, 24
3. Yang, L. (2018) Research on the design and behavior pattern of the campus landscape environment, Green and Environmental Protection Building Materials, 18 (10): 30
4. Li, S.M. (2018) Participatory campus Landscape design based on college students' behavior patterns, 47–49
5. Zheng, X.D., Xu, J.J., Wang, L.X. (2018) A student-involved study on campus landscape design, Landscape Architecture, 03, 32–37
6. Li, R.L. (2020) Participatory landscape planning and design of university campus, 16–17
7. Mihyun, K., Phil, C., Craig, E.W. (2015) Design for experiencing: participatory design approach with multidisciplinary perspectives, Procedia - Social and Behavioral Sciences174: 832

8. Song, Z., Agnès, P. (2021) International Chinese Students in the UK, Sustainability 2022: 2
9. Surjanti, J., Soejoto, A., Dwiarko, N.S., Waspodo, (2020) Mangrove forest ecotourism: Participatory ecological learning and sustainability of students' behavior through self-efficacy and self-concept, Social Sciences & Humanities Open 2: 2
10. Shutaleva, A., Martyushev, Nikonova, Z., Savchenko, I., Vladlena, L., Novgorodtseva, A. (2021) Environmental Behavior of Youth and Sustainable Development, Sustainability 2022: 3