DOCTORAL DISSERTATION

A STUDY ON IMPROVING THE ATTRACTIVENESS AND ACCESSIBILITY OF CAMPUS SPACE TO DEVELOP SUSTAINABLE UNIVERSITY ENVIRONMENT

by

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Abstract

A growing body of research has investigated the theory and practice of campus planning and architecture design. However, the research of post-occupancy evaluation by the actual space users (teachers and students), also recognized as an important element of campus space planning, has gained very limited attention. In developing China, after nearly 20 years of campus construction climax, the speed of expansion has dropped significantly and the focus of a sustainable and optimized green campus has emerged. Improving the accessibility, availability and attractiveness is a control determining if the public green and main building spaces can realize their values. Therefore, this study, taking cases, aims to explore and better understand students' usage conditions, perceptions, demands about campus public green and main building spaces. On Yijin campus in Hangzhou, China, through field observations questionnaire among 590 students, and accessibility analysis based on Space syntax theory, we have revealed that the negative usage condition of green spaces: most students rarely or occasionally visit the green space, and the visit time is concentrated in the afternoon and after class but rarely in the morning. Besides, students' gender and growth surroundings have little influence on the perception of campus green space, but the plant configuration, seasonal color richness and facilities required at different spaces will affect. Similarly, on campus of Yiwu Industrial and Commercial College, after the survey of 1,412 students, students' usage condition and actual needs of the campus are also drawn. In addition, the ranking of accessibility analyzed by Space syntax theory is similar to campus convenience considered by students. In the conclusions, suggestions are made about how to fulfill students' requirements and improve the attractiveness and accessibility of campus public green and main building spaces so that they may inform to the growth of emerging colleges and universities in other cities and countries undergoing campus construction climax.

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Chapter 1. Introduction

1.1. Background

1.1.1. Development of European and American universities

In the early 12th century, during the medieval period of Europe, the demand for science and knowledge promoted the development of higher education whilst the emergence of cities and increasing international trade. The teaching mainly focused on religion, civil law and natural sciences in early universities. The campus planning mode is mainly monastic, such as University of Bologna in Italy in (1158, considered to be the earliest university in medieval Europe), Sorbonne University (1170), and University of Oxford in England (1167) in Figure 1.1.

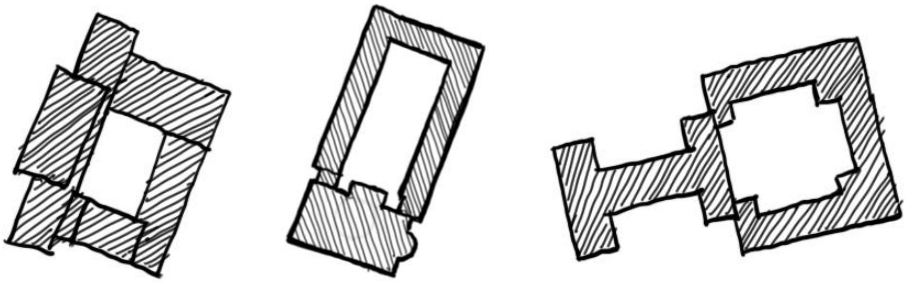

Figure 1.1 The campus of University of Bologna, Sorbonne University and University of Oxford

Gonville Caius created a new pattern of "open courtyard" campuses in the 16th century, with buildings on one side and walls on the other, such as Homerton College and Jesus College at Cambridge University (Figure 1.2) and Harvard College.

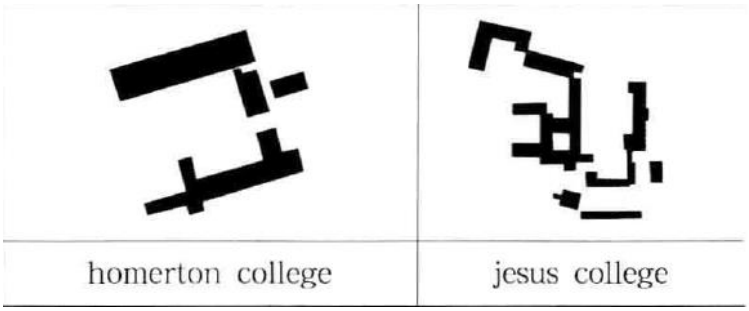

Figure 1.2 The campus planning of 2 colleges of University of Oxford

In the 18th century, campus planning mode in United States was constantly seeking for new and changes, also emphasized the affinity between teachers and students, the overall development of students, and the integration of campus architecture and nature. For example, University of Virginia has a free enclosure with a green space as the center and the library as the main part.

At the end of the 19th century, Omster, a famous American architect, presided over the campus

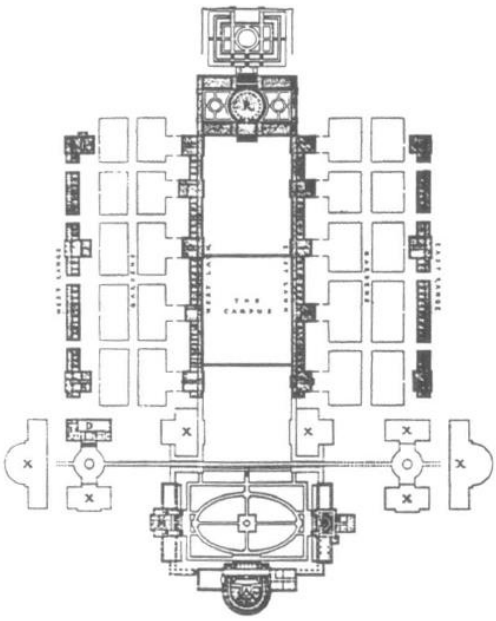

Figure 1.3 The campus of University of Virginia

planning of University of Berkeley (American free layout, as shown in Figure 1.4), who thought that the layout of absolute symmetry should not be emphasized too much and the asymmetric design was more conducive to the integration with the environment and future development and expansion.

In the 20th century, especially after the Second World War, campus planning tended to be multi-layered, diversified and multi-style and modernist architecture emphasized the practicality and functionalism of campus planning. At the same time, campus planning was considered as a dynamic process, and the head of Harvard University's planning office, who said in 1964 that their policy was "directed toward organized development," opposed permanent stability-a principle sacred to traditional campuses. Richard Dober, a famous American expert on campus planning, in his book campus planning (Richard P. Dober 1964), summarized the experience of the countries in the postwar world in building and expanding the campus, and also believed that the planning process should be paid attention to rather than the final form. The rapid economic growth in Europe, United States and Japan, and the soaring number of cars have given rise to a new approach to campus design: the campus layout of the school buildings along the road and parking lot of linear planning, as well as the "ring road" planning form. For example, South Florida College, designed by F.L. Wright, was a loose layout to form irregular spaces that are not square. The moving lines form roads at 30 °, 60 ° and 90 ° angle. This flexible form created the possibility of various shapes and layouts for Wright's individual buildings: hexagonal churches and theaters, circular libraries, and other square buildings and hexagonal and rectangular music buildings (Figure 1.5). Focusing on function, technology and use, became the basis and inducement for inspiration and creation of new architecture.

Figure 1.4 The campus of University of Berkeley

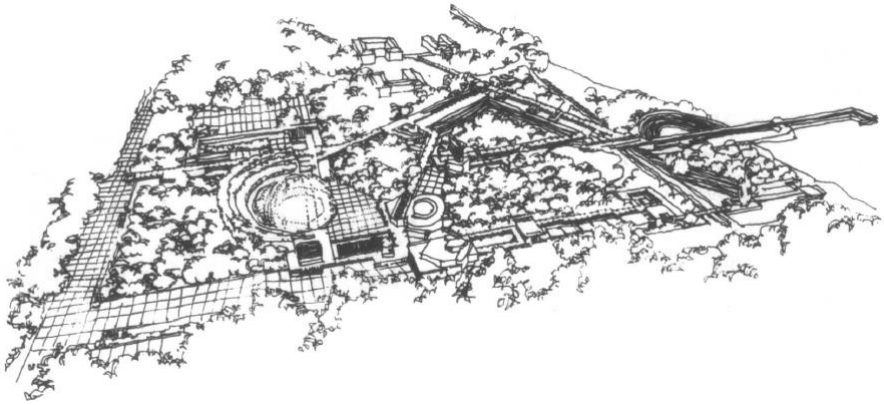

Figure 1.5 The campus of South Florida College

1.1.2. Development of Chinese universities

The campus of modern Chinese universities was developed in the westernization movement in the late Qing dynasty. The earliest establishment was the School of Combined Learning that set up in Beijing in 1862. The school buildings in this period were not large in scale, and most of them still used the old academies, imperial examination halls, royal palaces and government offices as their campuses.

In the early 19th century, when foreign missionaries entered China, missionary universities emerged, such as Lingnan University, Soochow University and Jinling University. Foreign architects and Chinese architecture students went to China to plan and design several important campuses, creating a number of very beautiful university campuses. For example, Tsinghua University (1914) and Yenching University (1921-1929), designed and planned by American architect Murphy, combined the functional requirements of modern architecture with the artistic conception of traditional Chinese gardens.

By the founding of People's Republic of China, China had 130 institutions of higher education, during which period, the university planning mainly drew lessons from the planning system of modern universities in Europe and the United States, with clear functional divisions. The teaching area was generally surrounded by a compound courtyard or quadrangle.

In the early days of the founding of People's Republic of China, planning and design were mainly to learn from the construction experience of the Soviet Union. The symmetry of plane layout, teaching area with the teaching building facing the school gate, teaching main building or library at the end of the central axis, two sides of the teaching auxiliary building in the overall form of neat symmetry pattern were excessively pursued, such as Huazhong Institute of Science and Technology, Xi'an Jiaotong University, University of Science and Technology Beijing.

Since China’s Reform and Opening, Chinese society has been in a period of rapid development and structural transformation. The gross enrollment rate of higher education jumped from 1.56% in 1978 to 15% in 2002.In the 1990s, it was further accelerated, especially in 1998, when the enrollment of students in colleges and universities expanded rapidly. In 2002, the number of students reached 9.03

million. Since the beginning of the 21st century, especially from 2000 to 2008, the peak period of university development and construction. Since 2008, the number of universities has expanded from high to low, as shown in Figure 1.6.

China has experienced nearly 20 years of campus construction climax, as indicated in Figure 1.6, the number of colleges and universities in 1998 is 1022, but at the year of 2017, there are a total number of 2631, super-over 2.5 times that of 1998, additionally with 30.18 million students in school, turned out to be amazingly over 8.3 times that of 1998 (Ministry of Education 2018). However, it is worth noting that in recent years, the speed of expansion has dropped significantly, and the period of large-scale college construction has begun to turn to the focus of a sustainable and optimized campus (Zijian et al. 2017).

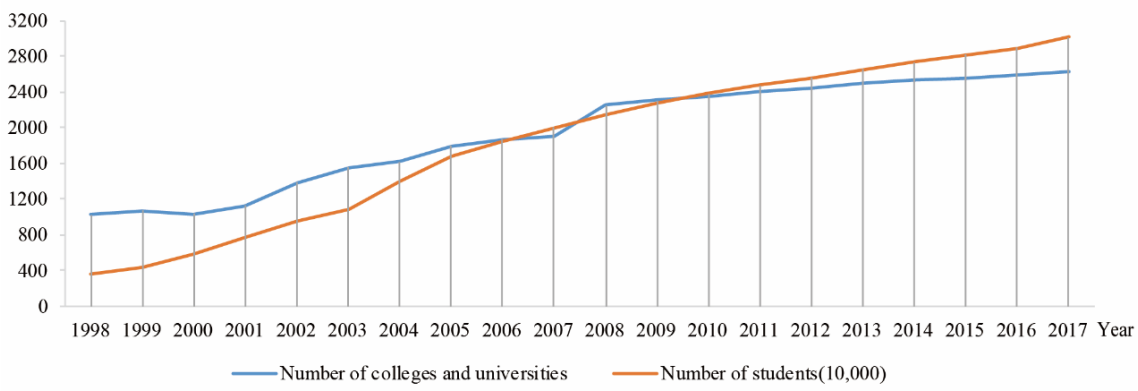

Figure 1.6 Development of the number of Chinese colleges and universities and students from 1998 to 2017.

1) South China University of Technology

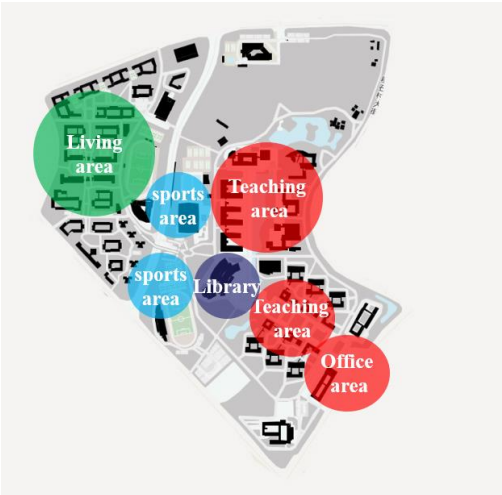

Figure 1.7 The campus planning of South China University of Technology

The Campus of South China University of Technology is close to Huishi Village to the east, nearby the Outer Ring Road and the Pearl River to the southeast, adjacent to the center of the city to the southwest, next to Zhonghuan Road to the west which is opposite to the living area of South China University of Technology, and adjacent to the campus of Guangdong Pharmaceutical University to the north. The teaching area of South China University of Technology covers a total land area of 81.8 hectares, with a total floor area of 469,220 square meters (including the area reserved for future development), an elevated floor area of 90,260 square meters and a basement area of 12,000 square meters. The campus has a capacity for 20,000 students and 3,000 faculties. In the planning, the design attaches great importance to the respect of natural environment and local conditions so that the natural landscape can become the subject and

the characteristic of the campus environment and thus improve the environmental quality.

2) Zhengzhou University

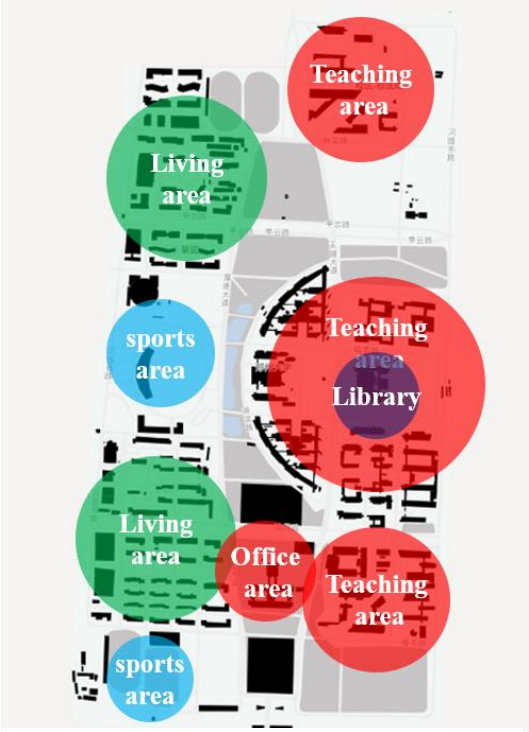

Figure 1.8 The campus planning of Zhengzhou University

In the overall planning of the campus, a university campus with distinctive characteristics is intended to be created in a large and featureless natural environment. The grid layout forms the structural texture of the planning and the unfinished arc forcefully outlines the core space of the campus, putting the campus with an area of 4,000 acres under control. A diverse and interactive behavior space is created at critical nodes, making communications and interactions a pleasing pleasure. The interwoven vertical and horizontal axes enhance the orderly sense of the campus Academic magnificence and the romance of college life provide good conditions for endless stories on the new campus.

3) Shanghai University

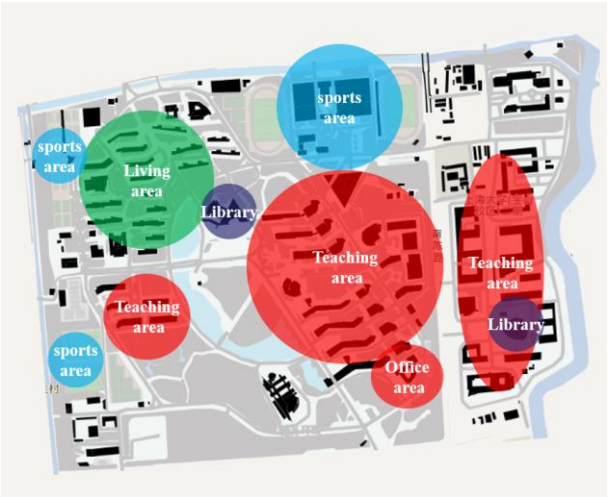

Figure 1.9 The campus planning of Shanghai University

Shanghai University was founded in 1983, The university has greatly improved the conditions of school operation through the constructions of "211 Project" and new campuses. At present, the university covers a total site area of 1,670,000 square meters and a building floor area of 890,000 square meters and the library covers a floor area of 64,000 square meters. At present, Shanghai University has over 40,000 fulltime students.

4) Yantai University

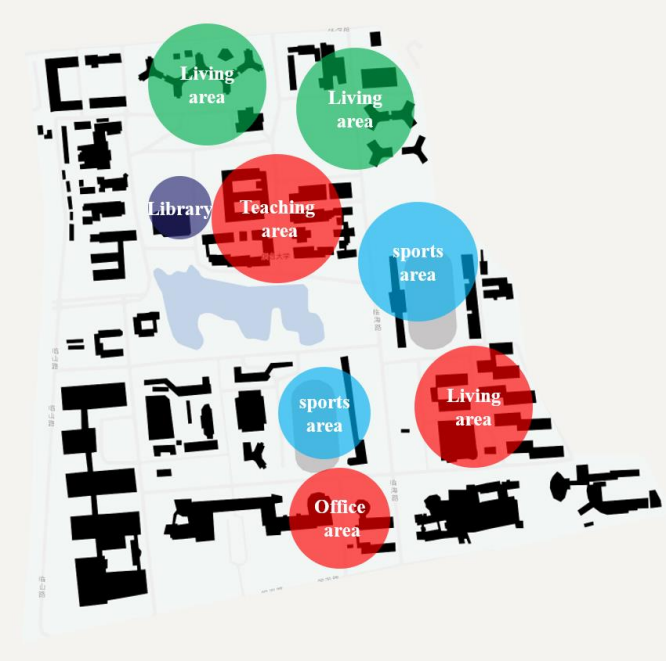

Figure 1.10 The campus planning of Yantai University

With the guidance of the approved expansion framework of the campus of Yantai University, the general plan of the expansion area received a further planning and design. The architecture layout of the newly expanded campus takes the two south-north and east-west axes as the center to form an orderly organic whole. With the guidance of regional ecoenvironmental awareness, the northern cold climate was considered in the design process so as to create personalized campus landscape with both the styles of the northern coastal regions and characteristics of the cold climate zones.

5) Nanjing Audit University

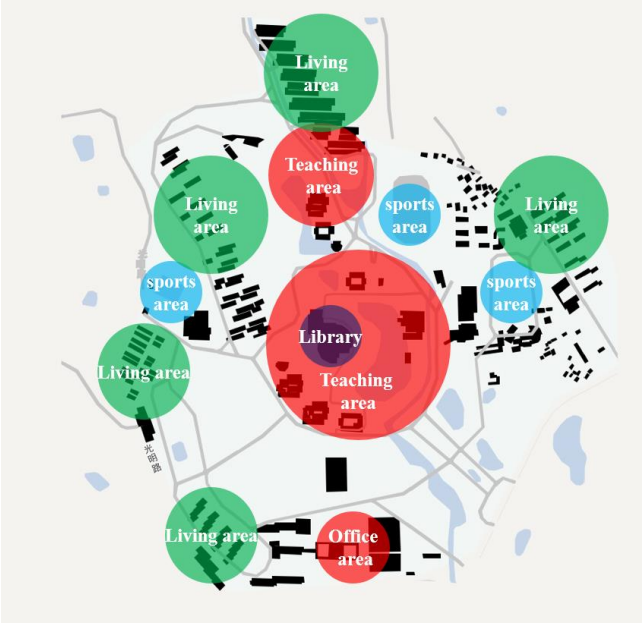

Figure 1.11 The campus planning of Nanjing Audit University

Nanjing Audit University, the only one university named after audit in China as well as in the world, was founded in 1983 as the only one university affiliated to the National Audit Office. The Pukou Campus of Nanjing Audit University is located on the West Road of Xishan, Zhujiang Town in the College Town of Pukou, Nanjing. The planning land area together with the land area of the original campus is about 2,000 acres. The size of teaching is set as 10,000 students in the short term and 15,000 students in the long term. The campus site is about 1480 meters from south to north and 880 meters from east to west, with large undulating terrain. The plan adopts mixed function zoning to form a multi-center lay out which can better solve the issue of the uses and linkages of a large-scale campus.

6) Zijingang campus of Zhejiang University

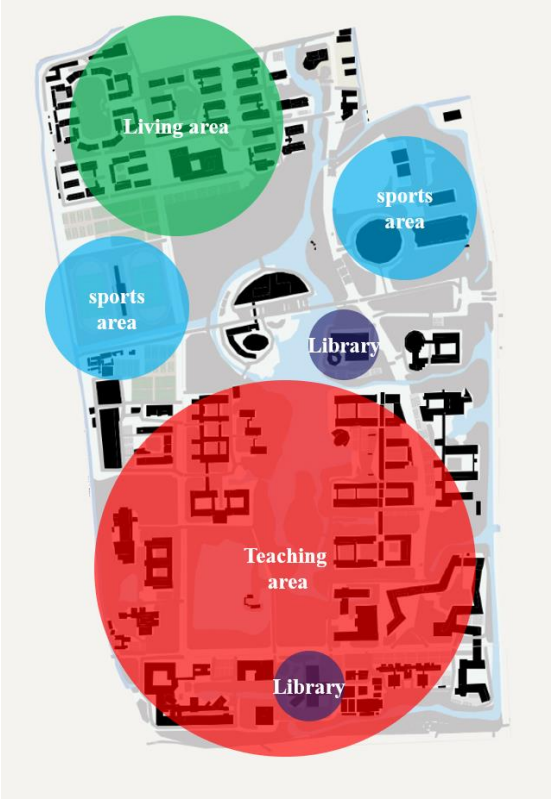

Figure 1.12 The new campus planning of Zijingang campus of Zhejiang University

The new campus of Zhejiang University is located 1n Hangzhou, Zhejiang. In design, the one-to-one pattern of teaching and life is adopted to resolve the problem of humanistic walking distance on a large-scale campus, and on the other hand, the artistic conception of "Faces Places" is adopted to organize the ecological zone. The entire campus integrates the existing water systems to connect dozens of large and small garden spaces through the "Faces Places" ecological belt. The ecological belt runs throughout the campus from south to north, the romantic tinge of water freely runs in between the rational campus buildings. Free water systems and elegant curving space, and precise network and neat square system are unified in contrast and conflict and thus form an organic whole.

7) Huxi Campus of Sichuan Fine Arts Institute

Figure 1.13 The campus planning of Huxi Campus of Sichuan Fine Arts Institute

Huxi Campus of Sichuan Fine Arts Institute has a unique "ten-sided ambush" architectural layout, creating a landscape effect of "With mountain chains and rivers ahead, I thought there was no way through. Why, shady willow trees and brilliant flowers keep one more village out of sight." The campus building is nestled between the mountains and complements the surrounding environment, giving a vibrant, fresh and natural feeling. This kind of tailor-made campus planning is unique in China.

8) Fuzhou University

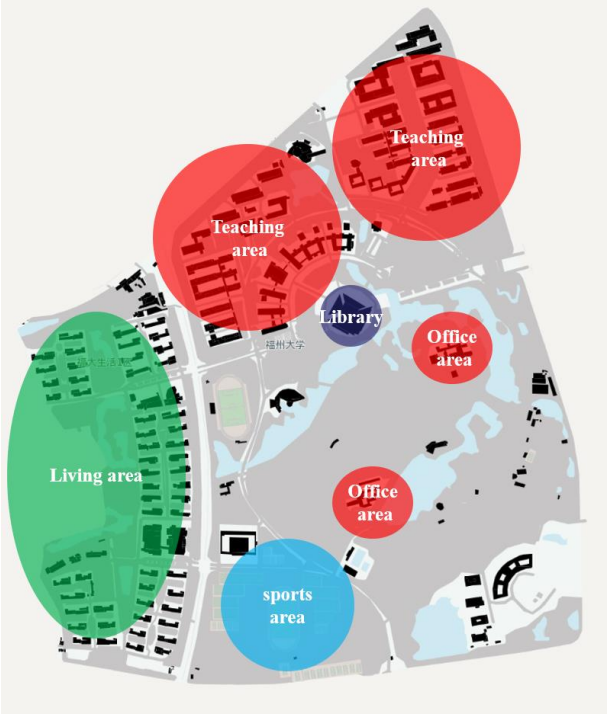

Figure 1.14 The campus planning of Fuzhou University

The starting point of the design is to try to retain the integrity of the mountain, set buildings away from the mountain and integrate the north canals to make one flow to the living area of students in the west and the other flow to the north throughout the core area and buildings of various disciplines so as to build a landscape garden style university campus. The master plan has two axes, the east-west axis has a turning point at the library, crossing the two main entrances in the west and east; and the south-north axis has a turning point at the mountain body, crossing the teaching area, laboratory area, central area and sports area. The two axes serve as not only linkages, but also the main landscape views of the campus.

9) Nanhai Campus of South China Normal University

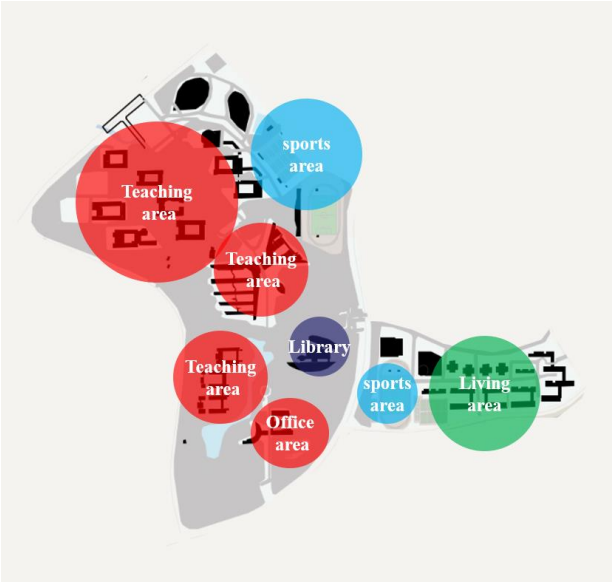

Figure 1.15 The campus planning of Nanhai Campus of South China Normal University

Nanhai Campus of South China Normal University was started in 2000 with a land area of over 330,000 square meters, a current floor area of 190,000 square meters and over 7,000 students at present. In the planning and design of the campus, the two natural hills in the south and north of the campus were retained to serve as the eco-green cores and thus formed the main structure of the campus. Buildings are laid out around the eco-green cores, keeping their ecological structures unaffected by artificial environment and maintaining integrity and independence. As to the architectural design, full-bodied academic flavor was created through the courtyard-style layout and characteristic pitched roof shape.

10) Xiangshan Campus of China Academy

Figure 1.16 The campus planning of Xiangshan Campus of China Academy

The Xiangshan Campus of China Academy of Art is located in Xiangshan block of the center of Zhuantang Town in the suburb of Hangzhou, and divided into the North Block and South Block along Xiangshan Mountain, with a planning land area of 703 acres. Phase one of the project covers a site area of 198 acres and a floor area of 64,000 square meters. The center of the campus consists of 10 buildings, which are laid out in the basic pattern of the variation of traditional Chinese courtyard building.

The campus, especially after 20th century, is like a semi-closed community, where the students spent most of time. There are often tens of thousands of students in the school, so the campus scale is usually large. Chinese university campuses have such an important impact on students' college life. Therefore, universities should have very good accessibility and attractiveness to enrich the college life of students. The above Figure 1.17 is a very typical case of campus planning in China after the 20th century. After entering the campus main entrance, there are office and teaching areas, then library and sport area. Living areas are often arranged in the corners of campuses and in more remote places. Students' living, dining and shopping in the living area, study in the library, exercising in gym and playgrounds, and having classes in the teaching area are all in the campus area, which can be seen that the university campus, especially a campus with good accessibility and attractiveness, is so important for the growth of students and the development of sustainable university environment.

The general trend in the planning and design of university campuses today is to first combine the different characteristics of various colleges and universities and organically combine the behavioral environment with the image environment to form an elegant campus culture atmosphere with elegant surroundings. Second, we must adapt to local conditions and continue and develop regional cultural characteristics. Third, we must pay attention to the sustainable and healthy development of the overall environment of the university campus; finally, we need to pay attention to the spatial shaping of intensive, economic and ecological campuses. Today's designers need to adapt to the new requirements of the new economy and new model for the design of university campuses in the new century,

constantly explore and innovate, find a working model suitable for their own architectural creation and development, and constantly adapt to the rapidly developing social needs.

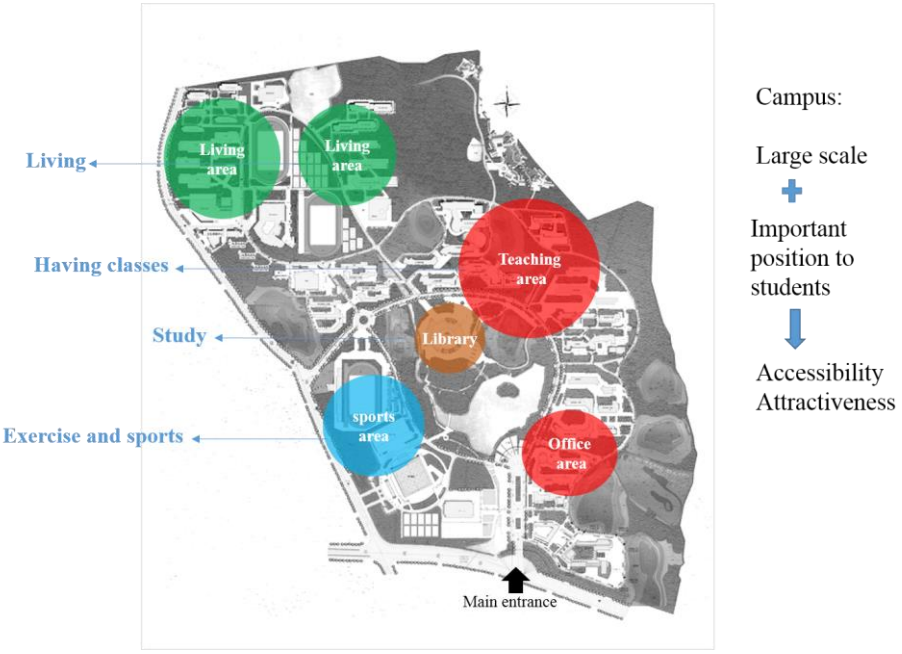

Figure 1.17 The campus planning of Zhejiang A&F university

1.1.3. Research statement of campus planning

After a comprehensive survey of the current space planning and design of university campuses in China, the author believes that there are many problems, such as short planning and design cycle, insufficient program maturity, lagging in the updating of design standards, and the lack of regional characteristics in the design.

（1） Short scheme design period

The academician Jingtang He, pointed out in his article “Concept, practice, outlook- the contemporary university campus planning and design”, such extraordinary speed, huge scale and complex functions are the outstanding characteristics of current university campus planning and design, and also the realistic requirements of Chinese current social education development. But in terms of the design cycle, most of the current planning and design of the new campus have encountered an extremely embarrassing situation: the design cycle is completely inadequate. Usually, the design cycle given by the school is only half a year or even three months, which is too short for designers to finish the work. So, they have to lower quality to ensure the design progress. Finally, the overall planning of the campus can only focus on the large functional pattern and ignore the detailed space design. On the other hand, the extremely compressed design cycle causes designers to have not enough time to think and innovate, leading to the reuse of design schemes.

（2） Insufficient program maturity

In the initial stage of program design, many school authorities often have no clear future development direction of the school, and the relevant information provided is not complete and systematic; many ideas are only at the initial stage, which results in the overall campus planning is often only at the level of one-time plan design. As a result, the phenomenon will appear that "design by stages, design and construction at the same time, the architectural style blossomed", in the process of construction drawing design and construction.

（3） The lagging design specifications

During the rapid development of university construction period, the basis of university campus construction standards can only be referred to, is the “Building planning area index of ordinary colleges and universities”, promulgated and implemented in 1992.This construction standard relative to the current rapid development of the university campus construction is quite lagging behind. Some relevant data indexes listed in the index of building planning area of ordinary colleges and universities are no longer applicable to the current situation of teaching development, and is far from the current trend of modern higher education emphasizing the development of new subjects and interdisciplinary subjects. In the process of designing the functional buildings of the university campus, they can only refer to the architectural design code for primary and secondary schools and some related types of public buildings. There is no special design code for guidance, which greatly restricts the development of the space planning and architectural design of the university campus. Therefore, the author believes that the current standards can no longer well reflect the development trend of university campuses, and new standards are urgently needed.

（4） The design lacks regional characteristics

In the process of new campus planning and design, local ecological regional characteristics are often ignored, so that the original unique space environment tends to be single. In such scheme design of this kind of university campus, the original high and low rising site was razed to the ground, and the original natural rivers and lakes were filled up, instead of artificial landscape, which eventually led to the appearance of campus planning in the form of "one side for thousands of people”. This is especially reflected in the treatment of water space. Many university campuses planning and design adhere to the "large water is ecological" design concept, resulting in "the school must be surrounded by water", but the site's original topography, climate characteristics and other objective natural factors are ignored. It is undeniable that water plays an important role in landscape planning and design, which can foil the architecture and soften the environment. However, unless the site itself has relatively sufficient natural water sources such as rivers and lakes, the landscape water system may become gutter and sewage pool due to improper maintenance and management problems in the later stage if a large area of water

surface is formed only by taking groundwater or even artificial irrigation. The environmental design of the university campus should be based on the combination of nature, rather than following the fashion. It should be built according to the existing natural environment of the site, instead of just paying attention to the architectural entity and ignoring the space environment, resulting in insufficient campus cultural atmosphere.

In modern society, change is normal. It is impossible for us to accurately predict the future trend of university teaching mode and its impact on campus space development. Therefore, the author believes that in the stage of space planning and design of university campus, we should carry out active, sustainable and dynamic guiding ideology, and focus on the variability of design, so as to strengthen the adaptability of university campus to future changes.

1.2. Research questions

(1) What is the usage condition of the main campus buildings and public green spaces? What are the factors that affect the usage?

(2) What is the accessibility of the main campus buildings and public green spaces? What is the impact on campus space utilization and student experience? How to improve the accessibility of campus spaces?

(3) What adjustments of campus planning can be made to enhance the accessibility, availability and attractiveness based on post-occupancy evaluation to analyze students' perceptions and needs of campus spaces?

1.3. Research objectives

This survey, therefore, aims at investigating students' perceptions toward campus green spaces and main building spaces, then further studying the accessibility and attractiveness of campus spaces.

In specific, in the context of a university in Hangzhou and a college in Yiwu, based on the field observation, questionnaire and Space syntax theory, this study is designated to:

(1) Investigate the utilization of campus public green and main building spaces and students' perception.

(2) Carry out the characteristics and more needed functions of the campus public green and building spaces.

(3) Analyze the accessibility characteristics of campus public green and building spaces.

This study is based on post-use evaluation to investigate the use of major functional buildings and public green spaces on campus, and analyze students' perceptions and needs. Use Space syntax theory to analyze the accessibility of campuses, thus providing an in-depth analysis of campus space.

1.4. Scope of research

The scope of the research is listed below:

(1) For a better research and analysis, six public green spaces of Yijin campus have been selected, and numbered from space-1 to 6. These six green spaces have below common characteristics:

- Publicity: The area of green space need be more than 1000 ㎡, excluding the small ones, which can guarantee that it will become a small central area and carry certain public activities.

- Integrity: Not separated by buildings or other spaces, the area can be a complete space.
- Pausibility: The space need be accessible and reachable, which means one or several paths should be inside, making students' staying, resting and so on possibly.

(2) 14 main functional buildings in Yiwu Industrial and Commercial College are chosen to be analyzed and investigated.

(3) Focusing research on student demand-oriented, questionnaires based on post-evaluation theory, and accessibility analysis based on Space syntax theory.

1.5. Research outlines

Chapter 1: Introduction

This chapter aims to explain the background of the study together with problem statement of research. Moreover, the objective and the scope of study are also explained in this chapter.

Chapter 2: Overview of campus planning and evaluation

The literature reviews of this dissertation are illustrated, a lack of consideration from other studies is drawn in details including Chinese campus planning, post-occupancy evaluation as well as occupant's satisfaction. The analysis framework is integrated and fulfilled by the study of Chapter 4, Chapter 5, Chapter 6 and Chapter 7, respectively.

Chapter 3: Research methodology

Aims to explain the case study and study process of research with the framework of integrated evaluation of campus public green and building spaces. This chapter is also described the step of analysis approach in term of qualitative and quantitative research. The research framework is provided for understanding the whole process.

Chapter 4: Analysis of respondents' perceptions about public green spaces based on post-occupancy evaluation

A typical case of Yijin campus of Zhejiang A&F University will be described on usage conditions. A field survey of occupants' satisfaction based on Post-occupancy evaluation methodology is used to understanding existing public green spaces by showing influence factor of satisfaction of students. And some conclusion will be made after the analysis of students' satisfaction.

Chapter 5: Analysis of the accessibility about public green spaces based on Space syntax

In this chapter, Space syntax theory is used to analyze the integration of campus green spaces and the link between the accessibility and the perceived security of students. The convenience will be quantified and thus some conclusions will be made.

Chapter 6: Analysis of respondents' perceptions about campus building spaces based on post-occupancy evaluation. This chapter mainly analyzed the information of the main buildings and the respondents in case-2. From this survey, we can see that the dormitory position plays a huge role in the selection of activities for students.

Chapter 7: Analysis of the accessibility about campus building spaces based on Space syntax

According to Space syntax theory and the global integration value calculated by the DepthMap, case-2 was analyzed This fully demonstrates that space syntax is feasible in campus planning, and its calculated accessibility is in line with the actual degree of campus access.

Chapter 8: Conclusion and Recommendation

This chapter summarizes the conclusions of the above 7 chapters. Based on the data and analysis results obtained in this study, the campus space layout of case-2 is optimized and re-calculated by Space syntax to ensure the accessibility and utilization can be improved in theory. At the same time, this chapter also gives some suggestions for the planning and design of new campus in the future.

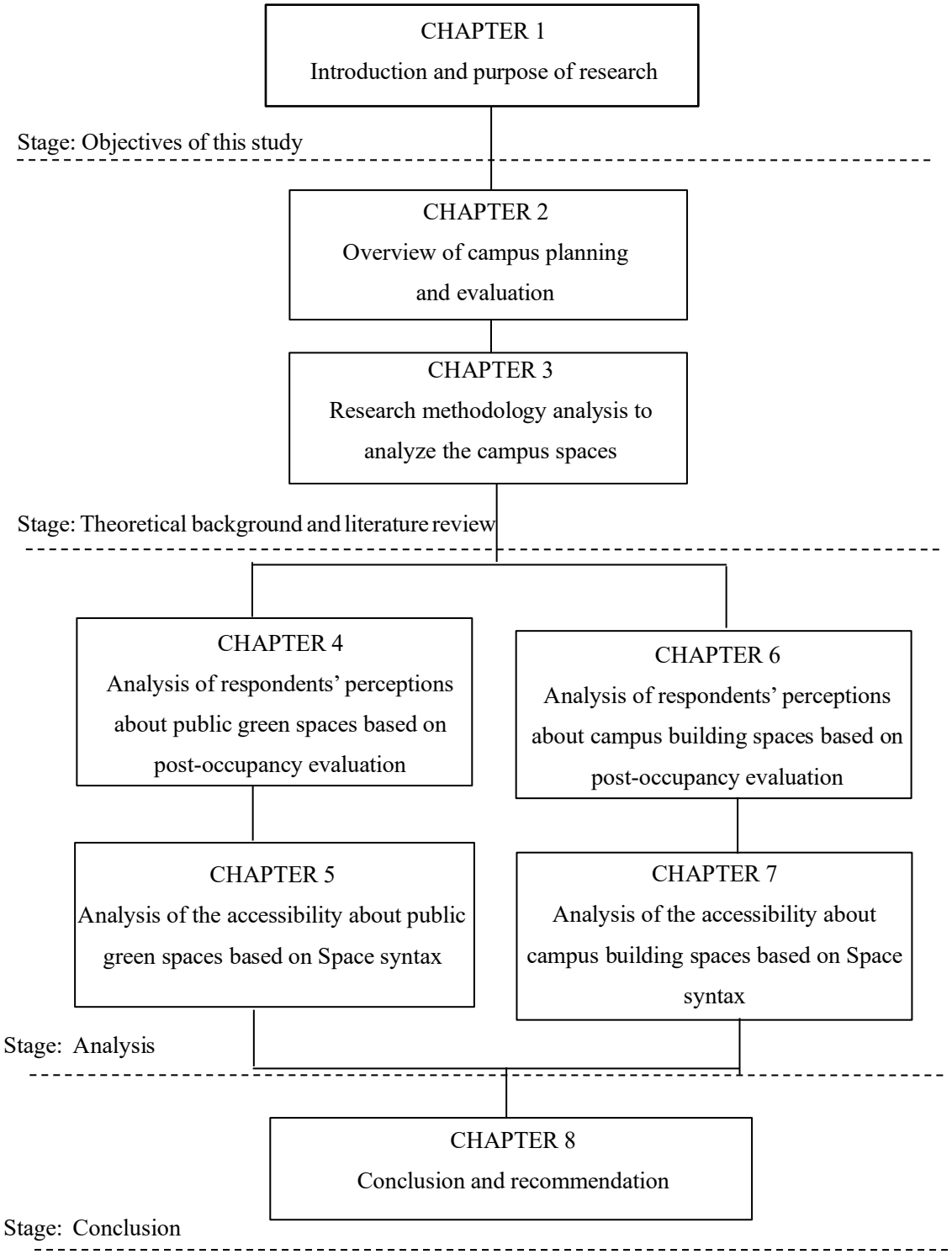

Figure 1.18 Research Outline

Chapter 2.
Overview of campus space planning and evaluation

2.1. Review of campus space planning

2.1.1. Review of European and American campus planning

Richard P. Dober, a famous American expert on campus planning, has written a series of books on that, among which Campus Planning (Richard P. Dober 1964), Campus Architecture (Richard P. Dober 1996) and Campus Landscape (Richard P. Dober 2000) are the most important. The book “campus planning” summarizes the experience of the construction and expansion of university campuses in various countries after the second world war, and emphasizes that the process of planning should be emphasized rather than the final form. The task of planners is to establish the guiding principles of development, and it is unnecessary to anticipate the trend of specific forms.

In the section of "People places-design Guidelines for Urban Open Space", the university campus outdoor space emphasizes that outdoor space is an area that people can stay in, rather than pass through, thus proposing detailed and specific design guidelines. And the research is mainly aimed at the outdoor space in this book, putting forward the method to solve the problem in view of micro level of the environment, or illustrating the author's opinion, even specific to each space characteristics and design point. but the book does not involve the planning level, the integrity of the outdoor space on campus, did not make a detailed analysis. The “Pausibility” of the campus public green space involved in this study is based on the research method of this book.

In the Book Oregon experiment, author C. Alexander used University of Oregon overall plan as an example to define a design approach, which is mainly the empirical details of institutional management and practical control. Most of the best places in the world are built by locals, not architects. The proposed user-participation design, organic renewal and fragmented development are indeed the essence of the concept. "it is the process itself that leads to organic order rather than fixed planning". However, is the urban renewal mode in developed countries suitable for China's current rapid urban development stage?

Thomas A. Gaines, the author of *The Campus as A Work of Art* (Thomas A. Gaines 1991), analyzed American university campus from the perspective of form, proposed to expand the campus planning elements, highlighted the role of art, took the external space as the primary factor to evaluate the campus, and evaluated the typical campus around the characteristics of planning, architecture and landscape.

In the book of *University Planning and Design*(Michael Brawne 1967), Michael Brawn analyzed the campus planning in Britain, the United States and Germany in the 1950s and 1960s.The author of *Campus: An American Tradition* (Paul Venable Turner 1987) , Paul v., enabled Turner examines the history of American university campuses from a diverse research perspective, and made a detailed introduction of the planning of American campuses, and so on.

Wan-min Zhao, the author of *mountain college campus planning theory and method*, systematically discussed the problems of solving the contradiction between construction and urban construction, such as the disturbance to urban planning caused by the super-normal construction of university campus or university town, through the analysis and comparison of the planning and construction of mountain universities in China and Europe and America.

2.1.2. Review of Japanese campus planning

The paper "Campus Planning and Design in Post-war Japan", written by Song, 1984 shows the planning and design of campus in Japan after the second World War have formed a characteristic style of their own, with considerations of domestic conditions and also of foreign experiences. The main points are:

1) Open type university: Emphasis in planning has been laid on the strengthening of the relation between the school and the society, so that improvements will be made in providing services in research, spare time education and other facilities to the society. At the same time, interrelations and exchanges between different departments of the school have also been considered to promote the development of frontier sciences.

2) High-density planning: In campuses in the urban areas, where the land is limited, the building densities are high. On the other hand, in campuses in suburbs or mountainous regions with more land, the building densities are also high in order to have close contacts between different departments, to improve the efficiency of facilities, to reduce expenses in pipeline networks and maintenances, to have more green spaces, and to reserve spaces for future developments. In the planning with high density, Japanese architects have elaborately planned architectural spaces with appropriate scale and varied forms.

3) Environment plan: Attention has been paid to make the campus convenient for the contacts between students and teachers, and for collective activities, forming a favor- able environment for academic training and temperament molding. Furthermore, historical style has also been noticed in making the new buildings in harmony with the existing campus.

The paper "A study in space organization and modification of university campuses in Japan", written by Ki SEO, 1991 is to obtain the fundamental knowledge on the space of campuses through the analysis and definition of the relative factors of its spatial composition and variations. There were seven types (street-axis, square-axis, square connection, square dispersion, building connection, street area-non axis, mixture-non axis) and were extracted as a result of classification on similarity of spatial

composition of 72 universities, 89 campuses in Japan, and on the factors (axis, grouping, circulation) that cause to frame the spatial composition. And through the analysis about the relationship between each type an 11 relative factors, and each type and its strength were verified.

The purpose of paper "A study on changes in the campus distribution patterns of Japanese university and college", written by Hiroyuki Marumo, 1987 is to clarify the factors which affect the changes in higher educational facilities in respect to the geographical distribution of campus. This was done by tracing their actual movement over the last three decades. Particular focus was given to national universities. Four patterns of changes were observed:

1) Unification of campus into one main campus.

2) Unification of campus to newly developed campus.

3) Addition of campus to existing campus.

4) Removal of campus without unification or addition.

As a result of this study, the following 4 factors affecting the above changes were clarified:

1) Conflicts between a desire for higher educational facilities to maintain a close internal integration and campus dispersion.

2) Conflicts between a desire for expansion of higher educational facilities and a rigidity of campus against growth.

3) Interdependency between higher educational facilities and the surrounding community.

4) Tendency for universities or colleges to physically symbolize past achievements and history.

While the first and the second factors tend to promote changes of distributional pattern of campus, the third and the fourth factors tend to restrain the physical movement or transfer of campus. Most observable changes in the campus distribution patterns of Japanese university and college can be explained by a balance between these four factors.

The paper of "City space and university campus—taking the spatial changes in japan national universities as an example", written by Wu yun, 2013, think that the university campus has its specific material and cultural functions in the development of a city. Tracing the historical changes in Japan National Universities, this article expounds the mutual relations between the city and the university in terms of spatial form, spatial location and spatial focus mode． It is found that changes in campus space form reflects mutual continuity and permeability between the city and the university, changes in space location the dependence of the university on the city, and changes in focusing means the independence of the university from the city．

2.2. The experience of American campus planning

The campus planning practice and theoretical achievements of the dynamic update of contemporary American universities are rich, and many universities in the United States have experienced hundreds of years or even hundreds of years of development. These American universities, which are well-

known in the world, have been widely recognized by the world for their practical effects of updating campus space planning and the tremendous advancement of universities in scientific research and social and economic development. Between the 1960s and 1970s, the dynamically updated campus master planning model has become the mainstream planning model for American university campuses. A group with represent of P. Dober and Paul V. Turner. of designers and researcher have carried out fruitful theoretical research on the campus master planning model and methods of contemporary American universities (Richard P. Dober 1964; P. V. Turner 1980). In addition, Society for college and university (SCUP), an academic organization planned by the United States, is very active, which holds many annual academic conferences every year and has carried out in-depth research on many advanced campus renewal plans. The field of campus renewal planning in contemporary American universities are remarkable because of many practical and theoretical research, which was worth in-depth discussion and reflection by Chinese campus planners and researchers.

2.2.1. The importance of master plan

The campus master plan documents directly affect the planning and construction of the university campus, and whether in China or the United States, they are directly guiding the planning and renewal of campuses, which are the main carrier of the design ideas of campus planning designers and also an important way for us to understand its design intent and planning control methods. The process of preparing the campus master planning documents is the process of carrying out the overall planning and design for the planning and design team. The implementation process of the campus master plan document, is also the control process of the campus plan update and construction of specific project projects, which determines how the campus planning documents are implemented into the campus's architectural and environmental space. Therefore, the campus master plan is crucial in the planning and updating of the campus. In addition, many US colleges and universities choose to disclose their campus master plan documents, which also provides favorable conditions for the study. Relevant research results will have outstanding practical significance for Chinese universities that are about to enter the stage of campus planning and development.

2.2.2. Dynamic update of contemporary American universities

The campus master plan of dynamic update of contemporary American universities is to guide the development of the existing campus in a specific period of time, establish a framework-based and flexible guiding principle (rather than depict a specific blueprint), and use this elastic guide, which can constrain and control the renewal construction activities. After the end of this specific time period and according to the conditions of the later campus and the university development strategy, the flexible planning guidelines for the next development stage will be again formulated, which, a dynamic, cyclical campus renewal planning model, will constrain the campus renewal construction activities.

2.2.2.1. The essential characteristics

The campus master plan of “dynamic update” of contemporary American universities has the following three essential characteristics:

（1） The “dynamic update” plan corresponds to the traditional “blueprint” plan.

Table 2.1 The comparison of dynamically updated campus master plan and traditional blueprint campus master plan

Type	Traditional "blueprint" campus master plan	“Dynamic update" campus master plan
Planning object	Generally suitable for the planning and construction of new campuses	Continuously updated, time-sensitive, framework-based, flexible planning guidelines
Planning document form	A one-time, meticulous depiction of the ultimate blueprint of the campus	Continuously updated, time-sensitive, framework-based, flexible planning guidelines
Planning implementation process	The completion of the entire campus in accordance with the blueprint marks the realization and completion of the “blueprint” master plan. Generally do not consider the improvement and update of the future campus environment.	The flexible planning guidelines constrain the campus development for a period of time in the future, focusing on the process of planning guidelines for the management of specific construction activities. After the interpretation of the role of each round of planning documents, the next round of planning guidance documents is continuously updated.

The “dynamic update” plan is based on the “blueprint” planning model and to a certain extent, the “dynamic update” campus master plan is based on the “blueprint” campus master plan. As a traditional campus planning model, the “blueprint” campus master plan is usually suitable for the planning of new campuses, that is, the planning method for opening new campuses from scratch in a short period of time, which generally includes a detailed depiction of the future campus space form and architectural features, and can foresee the completed picture after the implementation of the campus plan. However, the demand for higher education is constantly changing. When the campus planning is completed for a period of time, the current status of the static “blueprint campus” often contradicts the actual needs of the dynamically developing universities. Therefore, the “dynamic update” campus master plan emerged in this situation which is suitable for the development of existing campuses and its planning documents are flexible, framed planning guidelines and less detailed depiction for specific spatial forms and campus appearances. At the same time, this planning guide will be revised and updated regularly. The flexibility and adaptability of the “dynamic update” campus master planning model is reflected in its control of campus construction projects: during the period of the planning guidelines, as long as the proposed projects meet the control conditions in the guidelines, it can apply

for relevant approval and construction procedures, and thus better adapt to the changing needs of higher education development. If the “dynamic update” campus master plan mode is compared with the traditional “blueprint” plan mode, it can highlight the characteristics of the two plan modes (Table 2.1).

（2） A cyclical, dynamic update of the master plan document.

The “dynamic update” campus master plan has very significant cyclical and dynamic features. This planning model requires that the campus master plan document should be developed for a specific development time period (or a specific school population size). When the time is coming to an end, it is necessary to combine the current situation, the actual needs and the development strategy of the university to evaluate and adjust the planning plan for this stage, and to formulate a new round of the overall plan for the next stage. Documents should accommodate unforeseen changes in the future. Therefore, if a university adopts the “dynamic update” campus master plan, it will eventually form a series of campus master plan documents issued at regular intervals.

（3） Use flexible planning guidelines to control campus renewal construction, rather than depicting specific blueprints.

The “Dynamic Update” campus master plan requires flexible, framed planning guidelines, that is the framework design, in key areas of campus, proposed projects, campus transportation and parking, open space, architectural design, infrastructure, etc. And use it to control the future renewal of the campus construction activities. This guide document usually does not describe the final appearance of the campus in a specific time period, but adopts a more flexible and adaptable document format similar to urban design guidelines.

2.2.2.2. The emergence of dynamic update

In the historical evolution of American university campus planning, the 1960s and 1970s was a relatively important turning point, which was also the formation period of the campus dynamic planning model of “dynamic renewal” of contemporary American universities (Richard P. Dober 1964; P. V. Turner 1980; S. Muthesius. 2001). In the 1960s and 1970s, the rapid construction of cities and the vigorous development of economy in the Western countries after the Second World War exposed the shortcomings of the traditional urban and rural planning model, such as the lack of flexibility in planning and programming, and the difficulty in coping with the dynamic changes of the city, which is not a holistic, systematic planning, but a simple superposition. With the development of social ideology

such as gradualism and democratic consciousness of the contemporary era, the urban and rural planning thoughts of western countries began to shift from blueprint planning for the pursuit of final form to dynamic planning for the planning process. The planning ideas of the UK's dynamic planning,

US action planning and continuity planning, and Dutch program planning during this period showed similar major changes in Western urban planning. The American university campus in the 1960s and 1970s faced similar challenges (F. W.Mayer. 2015). After the Second World War, the promulgation of preferential education policies for American veterans and the increase of the birth rate after the war led to the rapid expansion of the number of American higher education, coupled with the transformation of the professional and curriculum education models. There is an unprecedented challenge. The traditional “blueprint” campus planning model lacking adaptability is gradually abandoned because it is difficult to cope with the changing development needs of the university (H. Helfand. 2002).

Under the background of the changing international environment of urban planning thoughts and the changing needs of higher education, a new type of "dynamic update" came into being (R. Moll. 1985). Richard P. Dober, an authoritative expert in the field of campus planning in the United States, systematically developed this dynamically updated campus master plan in the book Campus Planning (published in 1964) (Richard P. Dober 1964), who pointed out that this dynamic update of the overall planning model should require universities to develop corresponding campus planning guidelines for construction, transportation, landscape environment, open space, infrastructure, etc. according to the population size change in the specific time period in the future, and this framework-based planning guide is used to constrain campus renewal construction activities in specific future, which need to be continuously and dynamically updated. And Paul V. Turner believes the reasons that the American university campus planning model in the 1960s and 1970s evolved from a “blueprint” plan that pursues the final effect to a dynamic update planning model that emphasizes the planning process and public participation are two reasons: on one hand, the rapid development of post-war higher education made people realize the complexity and unpredictability of modern university education; on the other hand, it was because of the complete, detailed and precise “Blueprint” campus planning difficult to fully realize in the actual development of colleges and universities.

Contemporary American universities have adopted a continuous, incremental, and dynamically updated master plan design approach. Then, the planning and design process, the specific design method, how to control the construction effect of the campus space, how to integrate resources in the existing campus, optimize transportation and buildings, improve facilities and the environment, to adapt to the increasingly growing space requirements for development are all issues that are of great concern to the current campus planners and designers in China.

2.3. Review of campus space planning in China

With the expansion of practice of campus construction, there are more and more researches on university development in China. Especially at the peak of university development in the early 21st century, the research on university campus is very extensive.

The design team, represented by academician He Jingtang of South China University of Technology, has undertaken the campus planning and design of most provinces and cities in China. Guided by the " Holistic view, Sustainable development concept, regional, cultural, contemporary " theory of architecture, the team participated in a large number of universities, including Zhejiang university, Wuhan university, China University of Mining and Technology, Beihang University, Jiangnan University and so on. By using the method of hierarchical analysis, it establishes two sets of evaluation models, namely explicit and implicit, from the aspects of natural environment and cultural environment of the university. As shown in the hierarchical analysis list. And to the influence campus evaluation each index, has done the weight analysis (expert survey questionnaire). However, the composition of experts (the number of experts is also relatively small), the difference of experts' understanding of the problem and the design of the questionnaire all have an impact on the final result. The architectural planning and environmental design of institutions of higher learning, *The University Campus Planning and Architecture Design* (Song and Zhou 2006) not only involves the overall planning, space form, the external environment of campus, etc., also contains a single campus building design. which is very beneficial for the planning and single design for Chinese colleges and universities

"University campus group" (Qi 2006) studies the planning and architectural design of university campus from the perspective of groups, and attaches great importance to the mutual relations, values and evolution rules of campus buildings.

"Ideal space of campus planning in Chinese universities" (Tongji University) introduces a lot of examples of campus planning and gives comments on several cases.

Wanmin Zhao, the author of *mountain college campus planning theory and method*, systematically discussed the problems of solving the contradiction between construction and urban construction, such as the disturbance to urban planning caused by the super-normal construction of university campus or university town, through the analysis and comparison of the planning and construction of mountain universities in China and Europe and America.

（1） In the aspect of overall planning of university campus.

“A preliminary study on the spatial form of compact university campus--taking Dushuhu higher education district in Suzhou as an example” (Dai and Xv 2013), written by Yezi Dai, Ye Xu, mentioned that in the future, the higher education of our country will develop towards industrialization, diversified and open. Correspondingly, in the physical space of university campus, it must be compact, intensive and humanized.

Feng gang, “Harmonious coexistence of university and city -- a discussion on campus planning and design of group open university” (Feng 2009), combined with the design practice, put forward the overall open and partially closed campus design idea of group Open University, by analyzing the

characteristics of the campus design of the contemporary open university in China.

In “Design orientation and strategy analysis of "complexity" in campus planning” (Xiang 2009), Xiang ke proposed that the complex mechanism of university campus as a system had been formed and presented a self-organizing tendency.

Xu Li and Wanmin Zhao, in the “Solution of campus scale”(Li and Zhao 2009), put forward that under the new situation of campus construction, the scale of campus land should be determined reasonably, resources should be integrated and Shared intensively from the aspects of student scale, logistics socialization and sharing concept, so as to realize the positive interaction between the university and the city.

（2） In the aspect of campus architectural space design.

Yuen Tang in the “Diversification trend of library building and space” (Tang 2011), pointed out that the contemporary library architecture forms a trend of diversification in the aspects of body shape and public space creation, combination of urban cultural background, creation of comfortable and elegant indoor and outdoor environment, and pursuit of individuality and characteristics.

Hongbin Bian, Ying Zou, Hai Shang, and Daxin Zhang, in “Integration of campus environment based on external space -- concept and method of teaching building design of Tianjin university 26” (Bian et al. 2012), proposes the hope of maintaining the integrity of campus environment by understanding the integration of external public space.

（3） In the aspect of landscape environment design of university campus.

Yu Hou, Yuan Li and Shan Guan in the “Historical and cultural inheritance of landscape environment in the new area of university--a case study of Hunnan new campus of Shenyang Architecture University”(Hou et al. 2011), combined with Shenyang muddy south building university new campus built landscape environment empirical case, pointed out three methods of historical and cultural inheritance.

Zhang Huijie and Qiu Hongfei in "Talking about the Inheritance of the Context in the Campus Environment-Taking the Campus Environment of Wuhan Universities as an Example" (Zhang and Qiu 2010) -The article proposes that the campus environment should be constructed in accordance with the context of the campus, from the campus's natural attributes and humanistic spirit. Expounding the inheritance of campus context in modern campus environment from the perspectives of time and space.

Xia Guiping's "On the landscape forms of contemporary university campus planning and its construction ideas" (Xia 2012)-the article proposes to summarize the landscape level into four types of intentions: landscape signs, landscape nodes, linear landscapes, and homogeneous areas. Based on the geometric characteristics of the campus landscape form and people's subjective perception of it, it is advocated to guide the campus landscape design with gardening, ecological concepts and overall views.

From the research on university campus in China in recent years, it can be seen that the research on the environment design of university campus has received extensive attention and some regular recognition. In general, the university campus design research has been vigorously promoted, due to the large expansion of the current university campus. However, insufficient attention is paid to the campus environment in the design and construction, which leads to the insufficiency of the campus environment design to some extent. In addition, the current research perspective of university campus put more attention on a certain level of environmental design than the research on environmental integrity.

2.4. Post-Occupancy Evaluation

A widely used building performance instrument that has been developed in helping to improve the performance of the built environment is post-occupancy evaluation (POE). POE is recognized and valued among users or owners of buildings. A basic structured approach to evaluate the performance of buildings is recommended once buildings have been occupied. POE was introduced in the 1960s and then integrated into the first handbook of The Royal Institute of British Architects (RIBA) in 1965 (Bechtel 1997). The domains in which POE was applied at the beginning included housing, college dorms, mental health centers, and residential institutions with respect to environmental design (Harvey, Z. R., Hennings). In the 1970s POE was extended to use with large-scale buildings, such as public housing projects and schools, with an emphasis on technical and functional factors. This helped to increase the popularity and influence of POE (Francescato 1979) with research into a wide range of building types, such as offices, hotels, retail stores and shopping centers. POE was employed in studies during 1980–1990s particularly by owners who managed a large number of facilities and had an ongoing development and renovation programmer (Harvey, Z. R., Hennings).

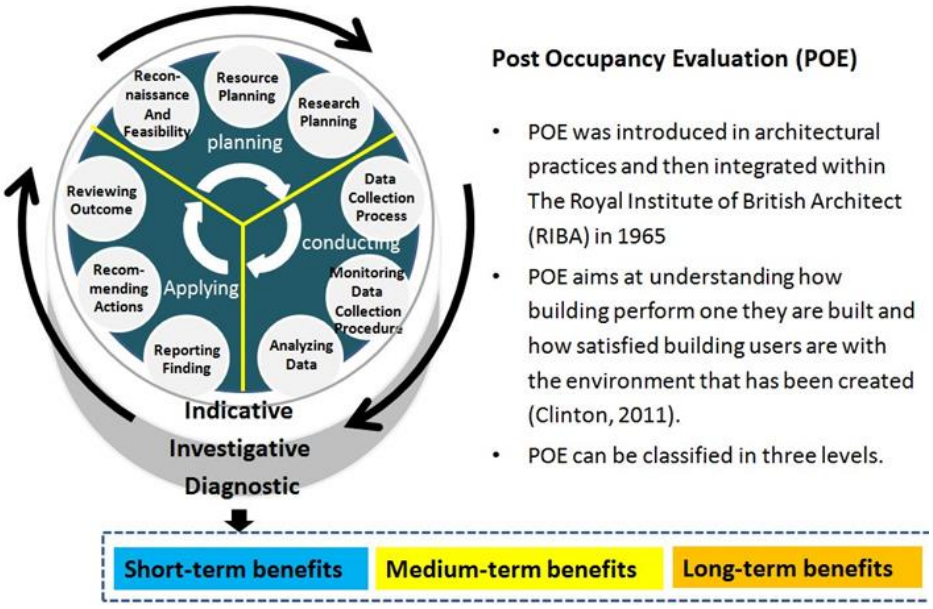

Figure 2.1 Post-occupancy evaluation frameworks.

The term POE is very broad as many theorists and practitioners have proposed various terms, namely "environmental design evaluation" (Zimring 2001), "environmental audit or building-in-use assessment" (Vischer 1996), "post-occupancy assessment", "facility assessment", and "building performance evaluations" (Clinton, O. A., Wellington 2011). However, in general, it can be seen as a broad range of activities aimed at understanding how buildings perform after they are built and how satisfied building users are with the environment that has been created (Clinton, O. A., Wellington 2011). The main features to be evaluated include users' satisfaction, users' assessment of building comfort and function, as well as users' behavior (Zimring 2001). Financial performance and the impact of building on the business process should also be considered (Heerwagen 2001). The POE concept has been further developed in various academic fields as most scholars were interested in POE based environmental psychology (Cooper 2001). Growing research on environment and behavior of social scientists, designers, and planners was developed to understand the building performance of occupants in representing "non-paying" clients (Zimring, C., Rosenheck 2001). Benefits from using POE are examined and include: a feedback loop to enhance continuous improvement processes, improved fit between occupants and their buildings, the optimization of services to suit occupants, the reduction of waste of space and energy, validation of occupants' real needs, reduced ownership/operational expenses, improved competitive advantage in the marketplace. The barriers to implementing POE are found to include: fragmented incentives and benefits within the procurement and operation processes, lack of agreed and reliable indicators, potential liability for owners, exclusion from current delivery expectations, exclusion from professional curricula(Zimmerman and Martin 2001). POE is broadly expanded in research and its application in environmental behavior, to consider the needs and lifestyles of the occupants for whom the housing development is intended.

2.5. Review of urban greening and campus green space

Urban greening is an important part of urban ecosystem and a main factor which urban planners and managers are usually faced (Belmeziti et al. 2018), providing residents with a wealth of ecosystem services, including saving energy (Xu et al. 2017), regulating microclimate (Amani-Beni et al. 2018), reducing noise (Li et al. 2010; Koprowska et al. 2018; Rey Gozalo et al. 2018; Nieuwenhuijsen et al. 2018), and purifying air (Dadvand et al. 2015; Nieuwenhuijsen et al. 2018). In addition to developing a sustainable city and environment, physical and leisure activities in urban green spaces will have a positive influence on stress reduction (Vanaken et al. 2018; Holt et al. 2019; Jennings et al. 2019), mindfulness, physical fitness, maintaining body weight, burning body fat and overall well-being (Carpenter 2013; Wüstemann et al. 2017; Nath et al. 2018).

According to the latest list of 2017 universities announced by the Ministry of Education (Ministry of Education 2017), there are currently 46 colleges or universities developing rapidly in Hangzhou (120.2°E, 30.3°N), which is the provincial capital of Zhejiang Province, the sub-provincial city, the

transportation hub of Zhejiang Province, the central city of the Yangtze River Delta, and the political, economic, cultural and financial center. In addition, the public greening in Hangzhou, as can be seen in Figure 2, from the year of 2005 to 2017, has grown very fast, much more than that of overall China. And Hangzhou's growth ratio of per capita urban public greening is also much larger compared with that of per capita area in China (National Bureau of Statistics of China; Bureau of Hangzhou Statistics(BHS) 2018). The campus green space, as a part of the public green area in Hangzhou, is worth exploring and analyzing.

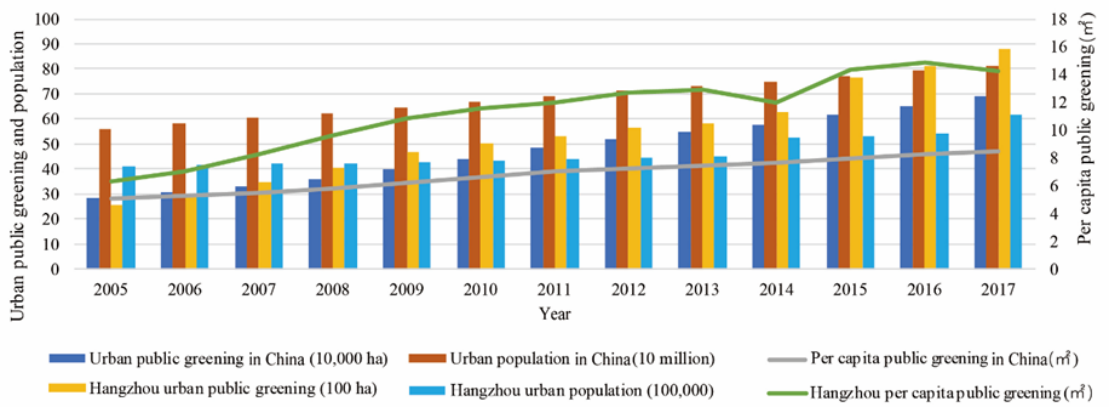

Figure 2.2 The development of urban public greening, population and per capita public greening in Hangzhou and China from 2005 to 2017.

For many cities all over the world, therefore, setting green spaces has been regarded as an important and robust approach (whether it is physically accessible, e.g.) to promoting the social welfare of citizens. The European Environment Agency (EEA) defines that green space should be set within a 15 mins walking distance (EEA 2006). In the UK, for the dwellers, a green space of no less than 2 ha within a 300 m radius should be set (Heynen 2003). Additionally, the goal that a green space of no less than 60 ㎡ per person within 500m is set by the Netherlands, more definitely (Roo et al. 2011).

Nevertheless, the accessibility, availability and attractiveness are also controls determining if the green spaces can realize their values. As a result, various studies on the integration between green space and citizens have been carried out (Bahrini et al. 2017; Fan et al. 2017; Stessens et al. 2017; Žlender and Ward Thompson 2017; Biernacka and Kronenberg 2018). For instance, the study (Bahrini et al. 2017) took 16 parks in Tehran, Iran as examples to find out the relationship among the distribution and usage patterns and their spatial accessibility. Wei (2017) analyzed the accessibilities of 41 parks in Hangzhou and observed changes from the year of 2000 to 2010 using the Gaussian-based 2SFCA method at the city level (Wei 2017). Fan et al. (2017) taking Shanghai as a city example, evaluated the accessibility to public green spaces of an urban periphery and illustrated how planning processes can influence the improvement of such accessibility (Fan et al. 2017). The exploratory study of Baran, Baran et al. (2018) using immersive virtual environments and judging from 48 persons' experience, found out the perceptions of fear and danger can be strongly influenced by Spatial configuration and physical

characteristics of landscape features (Baran et al. 2018). He and Zhu (2018) chose three communities in Hangzhou to explore the emerging changes of usage condition of community green space and the residents' attitude and behavior through interviews (He et al. 2018). Furthermore, there are many studies on the accessibility of urban green space, using GIS, Space syntax theory and Landscape pattern index analysis (Zhou and Li 2015) to analyze the green space qualities.

However, the above research is aimed at urban greening and the perceptions of residents, which may not be necessarily reflecting students' perceptions toward green spaces on campus. Issues about campus green space, also an important part of urban greening and a means of speeding up green campus development (Zhao et al. 2015; Washington-Ottombre et al. 2018), has gained very little attention.

The green campus development, is not only guided by the theory of sustainability in construction and operation of campus facilities, but also put the green concept and technology into campus planning and architecture design (Tan et al. 2014; Choi et al. 2017). However, it is found the researches mainly aiming at the energy efficient technology application and campus energy management, are lack of attention to the green campus planning, such as the land use efficiency and accessibility, especially lands of green space (Belmeziti et al. 2018; Xiao et al. 2018), which can not only enhance the green campus, but also provide good learning and working conditions for both teachers and students, and tardily penetrates them (Liu et al. 2018). If students can be in nature and green space, it will be positively to their self-rated restoration and health (Akpinar 2016; Liu et al. 2018). Therefore, how to make an optimized planning and design of campus green space to enhance its vitality and attractiveness, and increase the accessibility of public green space has become the focus of the implementation of green campus, certainly also a vital and meaningful topic.

This survey, therefore, aims at investigating students' perceptions toward campus green spaces and further studying the accessibility and attractiveness of campus green spaces.

Chapter 3.
Research methodology

This survey combined the methods of objective measuring and subjective evaluation to comprehensively analyze the campus public green and main building spaces. First, observed the overall situation of the campus, and investigated the existing condition of the public green space and the existing facilities and maintenance of main buildings. Secondly, in the form of questionnaires, did face-to-face interviews with students and investigated their evaluation of campus spaces. Finally, using space syntax theory, analyzed the accessibility of campus objectively, which was compared with students' evaluation of campus convenience.

3.1. Field investigation

To understand the study and community performance in current situation, the researcher has taken photo records as data collection. This method has been done during questionnaire and interview process of the case studies. Especially, this technique is important to evaluate building physical condition (applied in Chapter 4 and Chapter 6).

3.1.1. Yijin campus

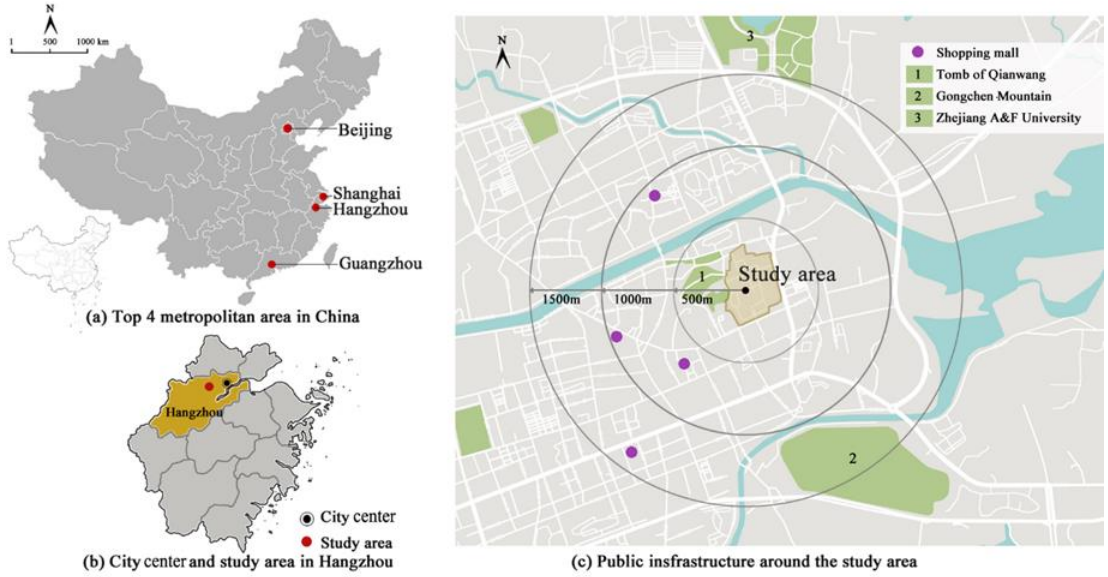

Figure 3.1 Location of the study area.

In this study, Yijin Campus of Zhejiang A&F University was selected as study area. As shown in Figure 3.1, Yijin Campus is located in Lin'an District, the west side of Hangzhou, surrounded by Yijin Street (South), and Lindong Road (East), and there are large shopping malls around making students' life relatively rich, but no urban green parks (only the Tomb of Qianwang with an admission charge and the Gongchen mountain with a steep hillside and a dense forest, which are not suitable for daily recreational use) in a 15 min' walking radius.

3.1.2. The campus of YWICC

Yiwu Industrial and Commercial College (short as YWICC) is located in Yiwu, the world's "commodity capital" and an international business city. As shown in Figure 3.2, Yiwu is located in the center of Zhejiang province, lying in the south of Shanghai and Hangzhou. The distance from Shanghai to Yiwu is 300 km, and from Hangzhou to Yiwu is only 120 km.

Figure 3.2 The location of Yiwu in Zhejiang Province, China

The predecessor of the school was the Yiwu branch of Hangzhou University, which was founded in 1993, and now a high-quality vocational college in Zhejiang Province, with currently 9,600 Chinese and foreign students. It covers an area of 35.59 ha (excluding the area of Jimingshan Park) and a construction area of 215,000 ㎡, with many hillsides and the Qunying Lake. As shown in Figure, there are 14 main functional buildings in the campus. They are Practical building (6 floors and the floor area of 19900 ㎡), Library (5 floors and the floor area of 11200 ㎡), Xuefeng building (4 floors and the floor area of 12128 ㎡), Gym (1 floor and the floor area of 20000 ㎡), Wangdao building (5 floors and the floor area of 19700 ㎡), Chunhan building (5 floors and the floor area of 19800 ㎡), Activity center (2 floors and the floor area of 10280 ㎡), Ladder promenade (1 floors and the floor area of 1540 ㎡), Lvzhuyuan apartment (from apartment-1 to 5, 6 floors and the floor area of 27200 ㎡), Lvzhuyuan dining hall (3 floors and the floor area of 12060 ㎡), Hupan apartment (5 floors and the floor area of 7600 ㎡), Danguiyuan apartment (from apartment-1 to 7, 4 floors and the floor area of 40740 ㎡), Danguiyuan dining hall (1 floor and the floor area of 5120 ㎡), Report hall (5 floors and the floor area of 8149 ㎡), with a floor area ratio of 0.60. In addition, the floor elevation of Activity center, Danguiyuan apartment and Danguiyuan dining hall are relatively higher than the other 11 buildings, which are flat and relatively compact. The school is surrounded by College Road (1 main gate and 2 secondary entrances and exits), Nanshan Road, Yidong Road (2 secondary entrances) and Jiangdong Middle Road (one secondary entrance). Due to the continuous construction and change of the campus, this study is of the current status in January.

3.2. Data collection

The data collection of this research study includes both primary data and secondary data. Qualitative and quantitative methods were consisted of the primary data, such as questionnaires, interviews, observation and case- studies of experiments, which were more described in details below this section. For secondary data, the related information to campus planning development in China, public green spaces on Yijin campus, and basic information of main buildings in YWICC were collected.

Qualitative analysis

It includes the data from interviewing students in universities, and field observation. Data analysis includes interpretation of the opinion of the respondents to identify the issue for improving campus environments. Usually, descriptive and explanation the result by content analysis were adapted.

Quantitative analysis

Quantitative analysis of questionnaires as general information on personal background (socio-economic, i.e., income, education level, living condition) were presented by descriptive statistic such as ratio, percentage, frequency, mean, and standard deviation (SD). T-test, one-way ANOVA, chi-square was employed for identify satisfaction to test differences of score based on independent groups. Correlation and regression analysis are a mainly tool for significant evidence of public housing performances in term of predicting factors. Statistics Package for the Social Sciences (SPSS) is mainly technique of qualitative data analysis.

3.3. Questionnaire

We designed a questionnaire for Yijin campus and a questionnaire for YWICC to explore the usage condition and factors that promote usage difference of public green and main building spaces, which, after assessment, no privacy issues were involved in. Besides, students were accessed face to face, consented information and acknowledged that he/she understood that participation in the study was voluntary.

3.3.1. Questionnaire for Yijin campus

The questionnaire was conducted in autumn, from September of 2018 to November of 2018, issued a total of 757 pieces, but 167 invalid, including unrecovered and recovered but not completed. Therefore, as listed in the Appendix, it recorded basic information on 590 students, and the first part was about their basic information, including gender, growth surrounding (rural area, small town, urban area or urban suburb), their grade (Grade 1, Grade 2, Grade 3, Grade 4 or Master), faculties and dormitories, and whether they love nature and the frequency of moving around on campus. Secondly, their perceptions of the six public green spaces, such as the plant collocation, seasonal color change, settings for rest, safety (the state of being safe and protected from danger or harm caused in remote positions or sparsely populated areas) and the overall satisfaction. The third part was about students' demand, that what functions they need in each space. The fourth part was to investigate students' usage period,

that when will they go out of the dormitory and move around on campus. The last part was to about students' feelings of the convenience from the main entrance, dormitories and anywhere of the campus.

3.3.2. Questionnaire for Yiwu Industrial and Commercial College

The questionnaire, only faced to students in YWICC, was conducted in winter, from January of 2018 to February of 2018. As of 2nd February, a total of 1412 pieces of questionnaires online was collected through the website of wenjuan.com, which was founded by Shanghai Zhongyan Network Technology Co., Ltd., and providing questionnaires for creating, publishing, managing, collecting and analyzing services for enterprises or individuals, whose questionnaire network now has been the largest free online survey platform in China. As listed in the Appendix, it recorded basic information of 1412 students, and the first part was about their basic information, including gender, their grade (Grade 1, Grade 2, Grade 3), faculties, dormitories, whether they have had part-time job and if yes, where is its place, the percentage of staying on campus and the main activities on campus (6 choices at most). This part is for clearly understanding students' information and daily behavior.

In the questionnaires, the number which is most appropriate to respondents' level of agreement/satisfaction should be circled. "1" means very dissatisfied. "2" means dissatisfied. "3" means fairly satisfied. "4" means satisfied. "5" means very satisfied.

The second part is about the space and indoor facilities condition of the campus. "Do you think the size of spaces of the 14 buildings is big enough and satisfy you?" "Are you satisfied with the size of school space in the overall campus?" "What do you think about the facilities and equipment in those 14 buildings? For examples, the operation machines in Practical building, the books and public computers in Library, and so on." "Are you satisfied with the facilities in the overall campus?" these 4 questions were to research respondents' perceptions about the space and facilities in buildings.

The third part is about the environment and entrance of the buildings in the campus. "Are you satisfied with the environment including the interior cleanliness, and surroundings' green spaces of those 14 buildings?" "Are you satisfied with the environments in the overall campus?" "Do you think it obvious of the following buildings' entrance?" these 3 questions are faced to respondents for understanding their evaluation about whole building environments on campus.

The fourth part is about the usage condition of the campus. "Usually, how many days do you totally stay in those buildings during one week? Please encircle the blank which is the most appropriate description of your time in these buildings." "Where do you do exercise more often?" "Why do you prefer to go to this place? (You can choose 4 of them)" "On average how many days per week will you go to this place?" these 4 questions are for analyzing students' use of space and frequency.

The fifth is to investigate the accessibility condition of the campus. "Do you think those 14 buildings convenient to reach this building from your apartment, and any other buildings connect with these buildings?" "After the meal in canteen, what will you generally choose to do?" "Are you satisfied with the convenience in the overall campus?" and "What kind of tools will you mainly move by in the

overall campus?" these 4 questions were listed to students.

After the above questions and the investigated answers, students' satisfaction and perception of the main building spaces of the campus can be obtained in detail.

3.4. Techniques of SPSS analysis

Quantitative analysis of questionnaires as general information on personal background (growth situation, demand, the frequency of use and so on) were presented by descriptive statistic such as ratio, percentage, frequency, mean, and standard deviation (SD). One-way analysis of variance (ANOVA), was employed for identify satisfaction to test differences of score based on independent groups. Correlation analysis is a mainly tool for significant evidence of usage frequency performances in term of accessibility. Statistics Package for the Social Sciences (SPSS) is mainly technique of qualitative data analysis.

3.4.1. One–way ANOVA

The one-way ANOVA compares the means between the groups that researcher is interested in and determines whether any of those means are significantly different from each other. However, the one-way ANOVA returns a significant result, we accept the alternative hypothesis (HA), which is that there are at least 2 group means that are significantly different from each other. At this point, it is important to realize that the one-way ANOVA is an omnibus test statistic and cannot tell you which specific groups were significantly different from each other, only which at least two groups were. To determine which specific groups differed from each other, you need to use a post hoc test. The test has its own formula:

$$F = (SSE1 – SSE2/m) / SSE2 / n\text{-}k$$

Where, F = variance of the group means/ mean of the within group

variances SEE = residual sum of square

m = number of restrictions

k = number of independent variables

Variation

The sum of the squares of the deviations between a value and the mean of the value.

Sum of Squares is abbreviated by SS and often followed by a variable in parentheses such as SS(B) or SS(W) so we know which sum of squares we're talking about.

Degrees of Freedom, df

A degree of freedom occurs for each value that can vary before the rest of the values are predetermined For example, if you had six numbers that had an average of 40, you would know that the total had to be 240. Five of the six numbers could be anything, but once the first five are known, the last one is fixed so the sum is 240. The df would be 6-1=5

The df is often one less than the number of values.

P-value

Evaluation of the differences in data in Statistics. Under normal condition, the experimental results reach the level of 0.05 or 0.01, it can be said that there is a significant or very significant difference between the data.

p-value > 0.05, have no difference

p-value < 0.05, have difference

p-value < 0.01, have significant difference

3.4.2. Correlation

Correlation test examines the relationship between two or more variables separately, meaning that relationship between two variables is independent of other variables. These variables measure the strength and direction of the linear relationship between the two variables. The correlation coefficient can range from -1 to +1, with -1 indicating a perfect negative correlation, +1 indicating a perfect positive correlation, and 0 indicating no correlation at all (Diamond, I., Jefferies). However, to select variables for next regression model for a validate regression model, a correlation coefficient should be more than 0.3 or above denoting a strong relationship and those variables is required a p- value of less than .05 to indicate statistically significant (Saunders, M., Lewis, & P., Thornhill 2009)(Saunders, M., Lewis, & P., Thornhill 2009).

3.5. Analysis by Space syntax

3.5.1. Space syntax theory

Space syntax is a research program that studies the correlation between human societies environment, and space from the perspective that social structure is fundamentally spatial and, inversely, the configuration of populated space has a primarily social logic (Hillier 1997). This principle is very fundamental in landscape design, which aims to create a sustainable environment to allocate to different groups, people, or activities.

Space syntax is also defined as a graph-based theory used by architects and urban designers to examine how the spatial layout of buildings and cities influences the economic, social, and environmental outcomes of human movement and social interaction (Zhai and Baran 2016). Its techniques offer precise quantitative descriptions of the way in which the built spaces of a setting are organized (Hillier et al. 1993). According to Hillier et al. (1993), the social meaning of the environment arises from spatial composition, and the topological structure of an environment is a primary element by which a society creates and establishes roles to develop some types of social relationships. Therefore, constructed environmental spatial patterns incorporate and give shape to social patterns.

Space syntax is built on two recognized ideas that attempt to reflect both the objectivity of space and our intuitive engagement (Hillier et al. 1993). The first idea is that we should think of space not as the background to human activity, as we think of it as the background to objects, but as an essential aspect

of everything human beings do in the sense of moving through space. Movement is essentially linear, and interface requires a “convex” space in which all points can see all others and a variably shaped, often sharp, visual field referred to as an “isovist” can be seen from any point in space (Bahrini et al. 2017). The second idea, called “configuration of space,” indicates that human space is not only about the characteristics of individual spaces but also about the interrelations between the many spaces that make up the spatial layout of a building or a city.

3.5.2. Space syntax method

Public green space model based on Space syntax theory can greatly contribute to our better understanding of how these green spaces interact with movement flows in addition to revealing the reciprocities observed between campus road networks, movement flows and land-use patterns (Hillier et al. 1993; Xiana and Lipeng 2017). Several studies on various cities with different backgrounds have shown that the Space syntax theory, and its analytical methods, is an efficient and advanced way to quantitatively analyze urban areas in terms of accessibility (Kim and Sohn 2002; Mahmoud and Omar 2015; Srinurak et al. 2016; Alkamali et al. 2017; Bahrini et al. 2017; Zhai et al. 2018).

In most urban cases, two methods of Space syntax are used: Axial Line Analysis and Visibility Graph Analysis (VGA). In terms of analyzing road networks, Axial line analysis was mostly used due to its efficiency in address accessibility issues, which can be found from various examples (Kim and Sohn 2002; Alkamali et al. 2017). Therefore, in this study, Axial line analysis, the primary Space syntax method was used to analyze the campus road networks of Yijin campus and YWICC.

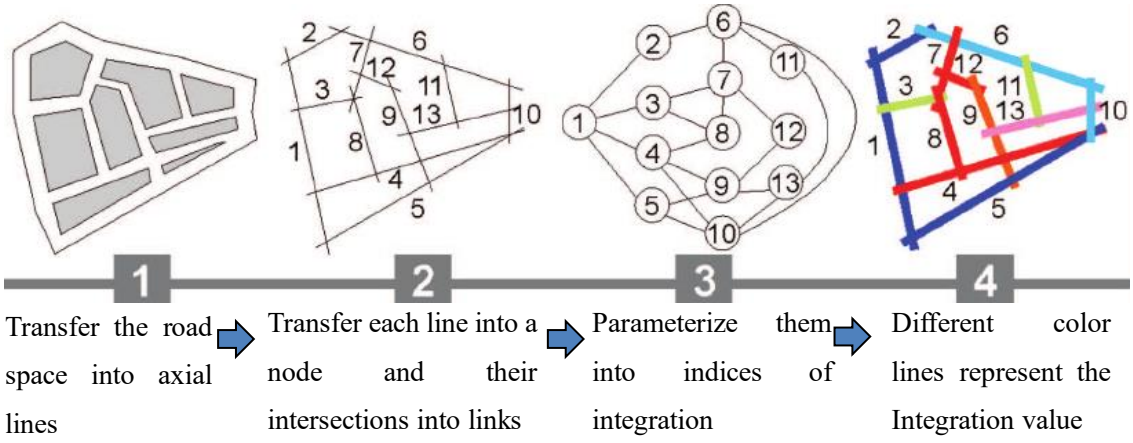

Figure 3.3 The process of axial line analysis by Space syntax theory

The main process of axial line analysis is shown in Figure 3.3. The first step is to transfer the road space into axial lines, corresponding to the longest and fewest line extensions possible crossing one or several spaces. Secondly, transfer each line into a node and their intersections into links. Thirdly, parameterize them into indices of integration. Finally, calculate the connectivity and integration value. A set of these intersecting lines with different colors obviously representing different values: higher values get a reddish color, lower values a blueish color, would form an axial map, which, subsequently,

is used to calculate the integration values of each line, measuring the degree of depth, or shallowness, of the spatial configuration under study (Turner 2004).

Several measures of quantifying configurational attributes of spaces, such as depth, connectivity, control, and integration, has been widely used in measuring public green space (Bahrini et al. 2017; Zhai et al. 2018).

(1) Depth

It is basically illustrated as the number of steps one must take to pass from one point to the other points (Hillier 1997; Jiang et al. 2000; Khalesian et al. 2009). The depth value is the smallest number of steps from a node to the others. It is defined as total depth and mean depth values (Eqs.1).

$$D_i = \sum_{j=1}^{n} d_{ij} \text{ and } MD_i = D_i/(n-1) \quad (1)$$

Where D_i=Total depth value of i[th] node, d_{ij}=shortest path between i[th] and j[th] node, n=Number of nodes, MD_i=Mean depth value of i[th] node (Khalesian et al. 2009).

(2) Integration

The "integration" of space is a function of the mean number of lines and changes in direction required to go from that space to all other spaces in the spatial system. Integration is accordingly about "syntactic" and not "metric" accessibility, and the expression "depth" rather than "distance" is used to illustrate how far a given space is from another space. All lines in a spatial layout have certain depth values from every other line. The integration value of a line is a mathematical way of expressing the depth of a line from all other lines in the system. These values significantly differ from one line to the next but are one of the most significant properties of architectural, urban, and landscape spatial configurations (Hillier et al. 1993; Hillier 1997). According to Ortega-Andeane et al. (2005), a space is "integrated" when the other spaces have a relative shallowness in relation to it. A space is "segregated" when the other spaces have a relative depth in relation to it.

The integration of a point indicates the degree of connection or separation between one point and the general system or the subordinate system, which can be measured similar to relative asymmetry as the average depth of the node to all other nodes (Eqs.2).

$$\mathrm{RA}_i = 2(MD_i - 1)/(n-2) \text{ and } I_i = 1/RA_i \quad (2)$$

Where RA_i=Relative asymmetry value of i[th] node, I_i=Integration of i[th] node (Khalesian et al. 2009).

Global integration is an indicator of how easily one can reach a specific space from all other spaces (the overall campus in this case) and is a measure of syntactic accessibility, referred to as Rn. A higher integration value indicates that the space has good accessibility in the system, which needs to traverse fewer spaces to reach that space (Hillier 1997), and can be reached (or seen) by crossing least number of spaces from all other spaces, and theoretically speaking, therefore those spaces are easily and more frequently visited (Zhai and Baran 2016). Similarly, local integration value is the tightness between one node in contact with its surrounding (Taking the green space as a goal center, the topology steps are three), referred to as R3, where a more limited analysis is conducted.

(3) Connectivity

The connectivity of a node can be defined as the number of other nodes directly connected to it. Connectivity, path length, and clustering coefficient are three key measures for a topological analysis of a given space. They constitute essential measures for exploring small-world and scale-free properties.

Some studies have pointed out that integration is closely related to human spatial behavior. A consistent relationship has been found to exist between the spatial integration measure of an urban space and the observed human movement that flows in it (Hillier et al. 1993). Kim and Sohn (2002) reported a consistent relationship between spatial cognition and syntactic integration in urban areas. A pedestrian movement rate in an outdoor space can be predicted with other syntactic results from space syntax analysis. Several studies have been conducted to compare measured pedestrian movement rates and spatial integration (Hillier 1996; Dawson 2003; Raford 2003; Read 2001). The results endorse such relationships. Evidence suggests that the space syntax methods of representation and measurement of the spatial configuration of outdoor spaces could be useful in studies of planting design because they influence pedestrian movement patterns in urban parks. A higher connectivity means the trail segment has more neighboring spaces that user can come from and to, therefore may have a greater usage (Mahmoud and Omar 2015).

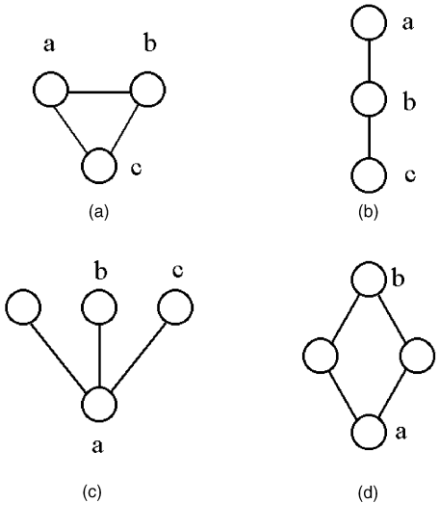

Figure 3.4 Relations of two spaces (redrawn from Hillier and Hanson, 1984, p. 94)

The relationship between the two spaces a and b is considered to be symmetric if the relation of a to b is the same as the relation of b to a. For example, in Figure 3.4(a), the relationship between a and b is symmetrical, as are the relations of both with c. In contrast, in Figure 3.4(b) the relation of a to b with respect to c is not the same as the relation of b to a, because one must pass through b to reach c from a, but not vice versa. The relation between two spaces a and b are considered to be distributed if there is more than on non-intersecting route from a to b, and no distributed if there is only one. For example, Figure 3.4(c) combines no distribution with symmetry from the point of view of a, while Figure 3.4(d)

combines distribution with asymmetry. Therefore, these will never be more than one route from one point to another in a no distribution system. However, a distributed system route will always form rings (p. 94).

Based on the Space syntax theory, the DepthMap software (developed by Alasdair Turner at the University College London) was used to analyze the configurational attributes on Yijin campus and YWICC. According to the actual entrances of the site, the integration values of axis lines are calculated and used as a reference index. But one space may have multiple entrances, which means multiple integration values of axis lines, surely, appearing maximum, minimum and average integration. In this study, the global integration degree of Yijin Campus was calculated, and each of the six selected green spaces' global integration value and local integration value was analyzed. Accordingly, the influence of spatial layout on the movement, and the usage condition of users are compared.

3.5.3. Application of Space syntax

Case 1: Analysis on the accessibility of green activity space on campus based on space syntax----- the case of Yijin Campus of Zhejiang A & F University

Introduction

Urban green activity space is an important place for social interaction group life, which is the carrier of urban society, economics, history and culture. Its spatial pattern is the basis of expanded social activities, and will also affect the behavior of residents. With the rapid urbanization of China, the green activity space area is increasing, as shown in Figure 3.5 (National Bureau of Statistics of China).

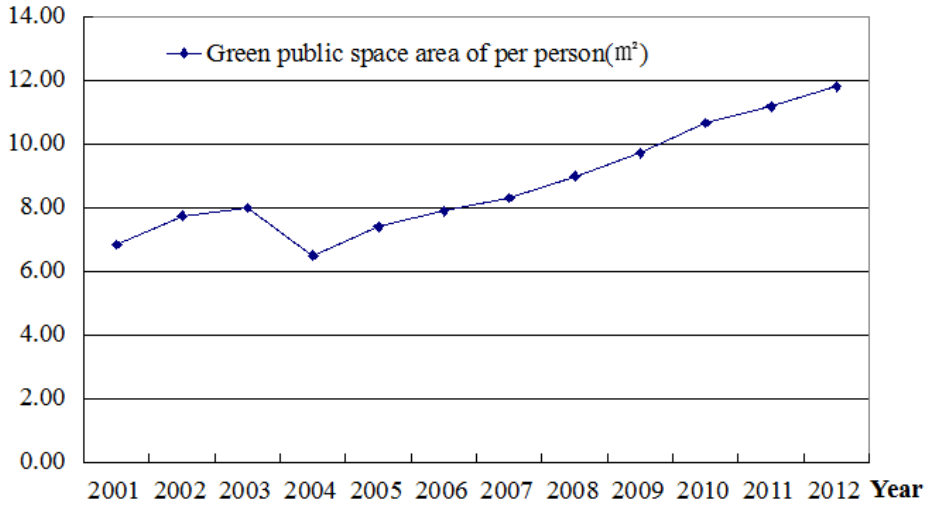

Figure 3.5 Green activity space area of per person in China from 2001 to 2012 year

Among them, the green activity space on campus are also increasing and obviously important, whose clients are mainly teachers and students on campus. The campus space will affect teachers and students as well as their understanding to the campus culture and spirits. Green space on campus provides the playing and learning places for students, teachers, staff families and other groups, which accounts for an important position in outdoors space.

1) Chinese campus

A certain area within the city, a large independent area, separated from the city by walls, ribbon like trees, rivers, and other regions. It is also equipped with a complete set of service facilities, such as teaching buildings, dormitories, and activity centers.

2) Green activity space on campus

Mostly, in Chinese universities, there are several green activity spaces, which will provide comparatively good scenery, with landscape, recreational facilities, and resting and exercising space. The students will have a rest and like to play in the green activity space.

3) Accessibility to green activity space on campus

Accessibility generally refers to the ease of transportation from one point to another point, starting from the perspective of daily transport infrastructure is a measure to the efficient allocation. From the urban planning point of view can be a conducive assessment to deepen the city's public service facilities rationalization and fairness arrangement. This paper will try to analyze how convenient from other parts of the campus to the green activity space.

Accessibility is a prerequisite for the use of space. If people cannot easily and quickly reach the space environment, it means a low utilization. And it is an important principle to evaluate whether the design of the campus green space followed the theory of people oriented.

Literature review

Bill Hillier thought that Space is the Machine (Hillier 1997), which reports a substantial body of research built on that theory, and a large number of articles concerned with different aspects of space and how it works. The theory of space syntax has been extensive used, and the theory is relatively consummate. But in China, this theory is not so popular used or there is more introduction than practical application or theory innovation.

As for the green activity space, there are lots of planning design and analysis. The campus design in the world has talked a lot about the green activity space design. However, domestic studies on green activity space on campus are lack of quantification, and most of the studies are from the subjectivity aspects by conceptual approach.

This paper is based on the theory of space syntax, using the concept of Integration value, and the software of DepthMap to quantify the spatial structure of the campus. Firstly, describe theoretically first combined with the existing data. Secondly, analyze the accessibility of green activity space on Yijin campus. Thirdly investigate the present situation through field research about the using frequency, the green activity space and the users' activities. Finally, from the perspective of accessibility of green activity space, make recommendations on the transformation of campus activity space (Yue and Wu 2013).

Research object

1) Yijin Campus of Zhejiang A & F University

Yijin Campus belongs to Zhejiang A& F University, which has the oldest history and most cultural atmosphere. The basic information of the campus can be seen Section 4.1. Basic information of public green spaces.

2) Green activity space on Yijin Campus

As Figure 2 and Table 1 showed, there are totally 5 main green activity spaces. The first one is beside the library. The second is playground of Yijin Campus, which is in the east of the campus. The third and fourth are between the teaching buildings and dormitories. The fifth is in the north and beside the second entrance. They all have some activity space, such as benches for rest and sports equipment. The rest of the green space is filled with plants, mainly used for view. This paper chooses the five green activity spaces to study.

Research Methodology

1) Analysis by Space syntax

The space syntax encompasses a set of theories and techniques for the analysis of spatial configurations. It was conceived by Bill Hillier and his colleagues in the late 1970s to early 1980s.Over the past decades, Space syntax have been used for research in information technology, urban and human geography, and anthropology (Hillier B. 2004).

Axial analysis

It rests on three basic conceptions of space: convex space, axial space and visibility polygon. This paper chooses axial analysis, which is one of the three basic ways to divide the space.

According to the spatial perception, divide the large-scale space into a series of small-scale space. The relevant index of each axis represents the convenience of movement, transfer, forward and other capabilities. And travel along the axial direction is the most economical and convenient movement6).

Integration value

The most basic variables of space syntax: connectivity value, control value, depth value, integration value, and intelligibility. Global integration value represents the tightness between one node in contact with all the nodes throughout the system; and local integration value is the tightness between one node in contact with its surrounding. According to this, calculating the integration value to represent the tightness between the green activity space and other space is reasonable and feasible.

The warmer the line's color is, the higher integration value will be. Conversely, the lower will be. Therefore, the integration value (Figure 3.6) shows that there are 5 roads that have the highest value, which means a high accessibility. The space surrounded by these high integration value roads will be more convenient to be reached. On the north of the campus, the integration value is lower, which means its position is relatively remote. The middle and east, are the most dynamic places.

Table 3.1 Analysis of the integration value of spatial structure

Number	1	2	3	4	5
Global integration value					
Maximum	1.18	1.39	1.38	1.38	1.18
Minimum	0.70	0.88	0.89	1.28	0.64
Average	0.92	1.16	1.10	1.33	0.90
Local integration value					
Maximum	2.37	2.20	2.42	2.42	2.57
Minimum	0.85	0.98	1.26	1.84	0.92
Average	1.45	1.63	1.78	2.16	1.59

Analyze the accessibility of green activity space, mainly according two variables, global integration value and local integration value (Take the activity as a goal center, the topology steps are three.). Take the actual entrances as the reference standard, and the integration value of roads which can reach this entrance as reference index. Extract the maximum, minimum and average integration value， as Table 3.1 shown.

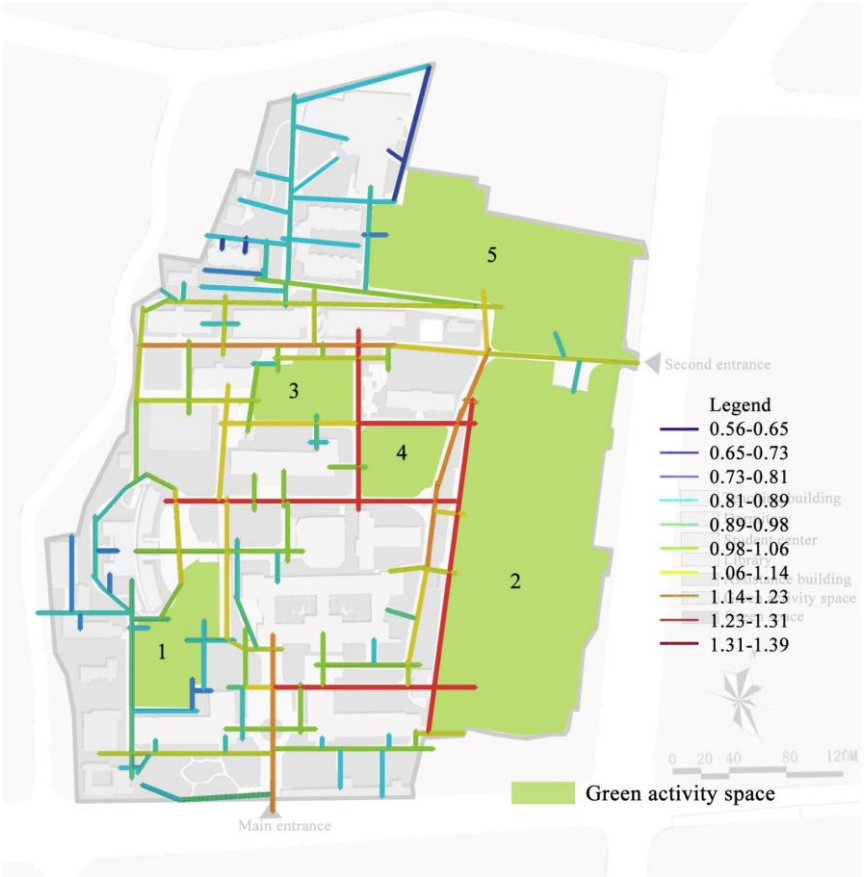

Figure 3.6 Integration value of spatial structure of Yijin Campus

In terms of the global integration value, the fourth green activity space has the largest average value of 1.33, which means this space has the best accessibility. If just according to the value, people will

more like to go to the fourth to play or rest. The fifth has the lowest average value of 0.90, which means a relatively remote position. It will be inconvenient to get to there. Obviously, its utilization will be limited.

In terms of the local integration value, the fourth green activity space also has the largest average value of 2.16. Others are roughly the same as the condition of global integration value.

2) Field research of 50 persons

The objects are mainly the students of Yijin Campus. Give questionnaires to the students, about the usage condition. Finally, there are 50 persons finished the questionnaires. The survey includes two questions. The first question is which two green activity space you use most frequently. The second question is evaluating the five green activity spaces from three aspects, including accessibility, site facility and landscaping.

Figure 3.7 is the usage percent of the green activity space, which shows that the second green activity space has a highest usage frequency of 39%. However, the fourth, which has the largest integration value, only is in the fourth common use position, 14% in this survey.

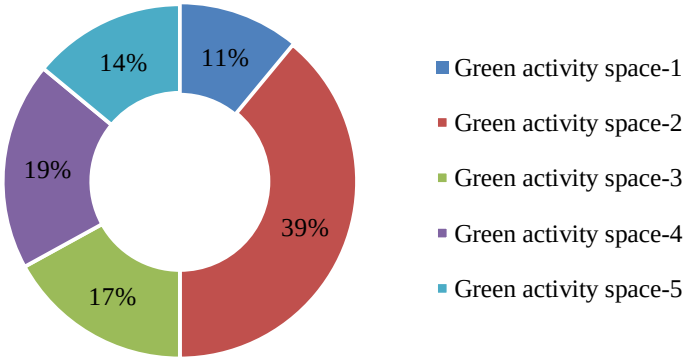

Figure 3.7 The usage percent of the five green activity spaces

According to the three aspects, analyze people's evaluation to the five green activity spaces. As Figure 3.8 showed, the fourth green activity has the best accessibility. Nearly 70% of the people think it convenient to arrive. Next is the second one. The order is totally the same as the global integration value of spatial structure of Yijin Campus.

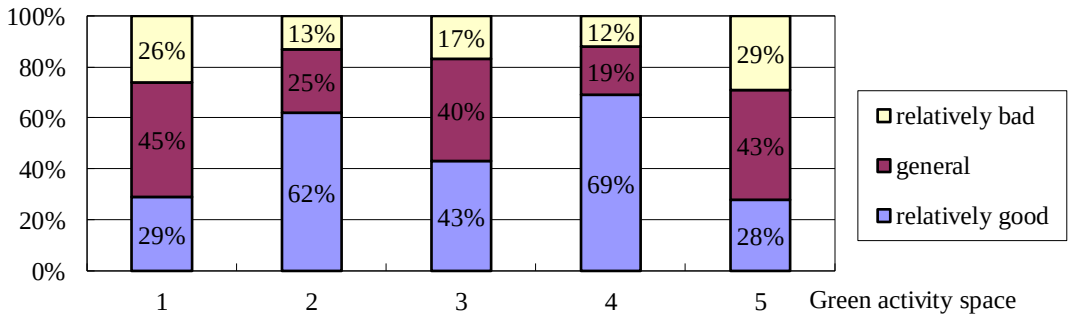

Figure 3.8 Evaluation about the accessibility of the five green activity spaces

Figure 3.9 shows that nearly 70% of the people think the facility situation of the fourth green activity space is relatively bad. After observation, we found the facilities in this site are old and shabby, and all plants. People have no place to rest. The second and fifth green activity space are relatively satisfying. Because the second green activity is a playground, obviously there are a lot of facilities in it. So even the accessibility is not the best one, it is frequently used by most people. After observation, we found people will walk round at dusk, or take exercise in the morning. The fifth one is basketball field; the users are mainly boys. Therefore, even the accessibility is worst, some people will also go to play.

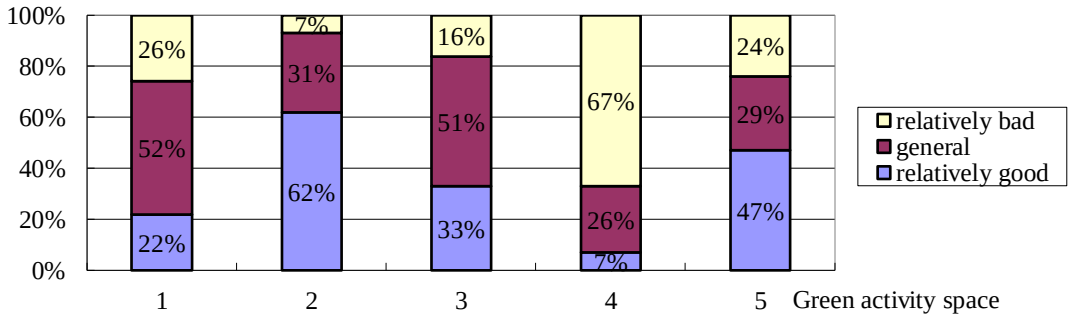

Figure 3.9 Evaluation about the facility situation in the five green activity spaces

Figure 3.10 shows that the landscaping in the site. The first land is beside the library, the landscaping is best. But because of its poor facilities, not so many people would like to stay. After observation, most people go out from the library and just pass the land.

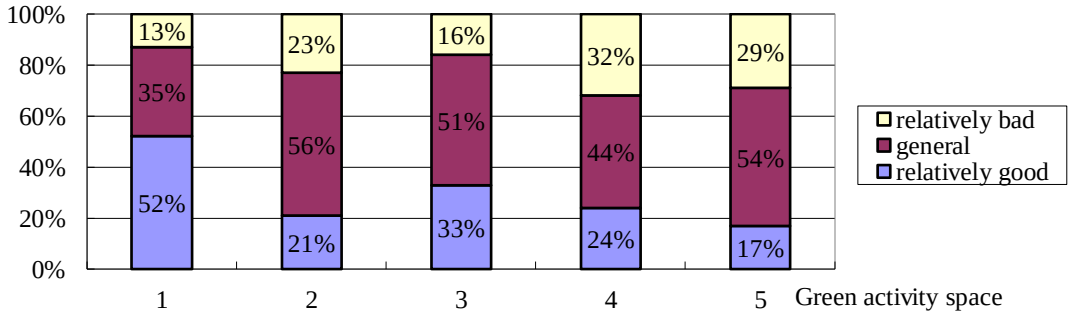

Figure 3.10 Evaluation about the landscaping of the five green activity spaces

Conclusion and suggestions

On the basis of the analysis by software and field research, the following can be concluded.

1) Integration value determines the accessibility of the space on campus and will affect its utilization.

The larger the integration value is, the better accessibility will be. That means it is more convenient for people to get there. Therefore, some space which will be needed by most people should be set in these better accessibility places. In this paper, the fourth green activity space has the largest integration

value, obviously its accessibility is best. The fifth land has a bad accessibility. Although the function will be needed by most people, the utilization is not so high. So, setting the more needed space in the better accessibility place is important.

2) Post-maintenance is equally important.

In the current situation, to maintain the fourth green activity space is most important, which may attract more students to use this space. Although it has occupied the most favorable position, that kind of low utilization is a waste of resource.

People's demand degree to the second green activity space is high, and its accessibility is relatively good. But its landscaping cannot be satisfying. Some measures, such as sun shading, plants and lake view can be taken.

This study figures out that accessibility is a method to analyze the spatial structure, but as for the utilization, it will be affected by lots of other elements. People's cognitive, the demand degree, and other elements to different space will be different, which will obviously affect the space.

Case 2: Analysis about the accessibility of urban communities of ring road system

The demand of urban communities has been rapidly increased with the urbanization of China. Hangzhou, as a metropolis of China, the capital of Zhejiang province, is undergoing this situation that some contradiction between the supply and demand has emerged. And in Xiacheng District, a main administrative district of Hangzhou, the earliest existing urban communities were mostly built in the 1980s. From the age of 1980s to nowadays, the community has changed a lot, no matter its quality or community style, and also developed a lot in different ages. Previous researches about the urban communities planning or criterion are rich and well thought-out. However, there is little analysis about the community itself or even none about its accessibility. The urban communities of ring road system are popular in the 21th century. More and more new urban communities start to adapt this road system type to organize its road network. But its accessibility and sustainability need timely researches and analysis. Compare to other road systems, whether these urban communities of ring road system account for an advantageous position. And the aim of this paper is to analyze the characteristics of urban communities of ring road system which are completely constructed after 2000 from the angle of accessibility based the theory of space syntax. This paper randomly chooses 4 communities after 2000 in Xiacheng District and then makes a comparative analysis between them. Get the basic information and community planning maps from the government websites, such as Hangzhou Planning Bureau and Hangzhou Housing Authority, and then have verification through the property management offices to make sure the data's accuracy. According to the theory of Space syntax and with the software help of DepthMap, get the integration value, which means the accessibility of urban communities, and then make a comparative analysis to them. The Yicheng Jiayuan Community has the best accessibility in these 4 ones. There comes out the general rules of development of ring road

system of urban communities. At the same time, it reflects the evolution of Chinese society and tries to figure out sustainable ways for the future development. And have a better understanding about the challenges and difficulties that appear during the urbanization in China. Is it possible to predict that social structure of space using Space syntax techniques? The answer appears to be positive.

Research background

With the increasing urbanization of the country, commercial and industrial lands squeeze people's living space. In China, the community is a certain area within the city, a large independent area, separated from the city by walls, ribbon like trees, rivers, and other regions. Some is also equipped with a complete set of service facilities, such as commercial outlets and kindergarten. There are several types of communities within different road systems. As Figure 3.11 shows, ring road system, endpoint road system and tandem road system are three common types to organize the road network (Chen 2009). The main road through the community is a circle road, which with branch roads are combined to form a road network system in an urban community. The urban communities of ring road system are very popular especially in the 21th century. Thus, this paper chooses the communities of ring road system after 2000 to analyze.

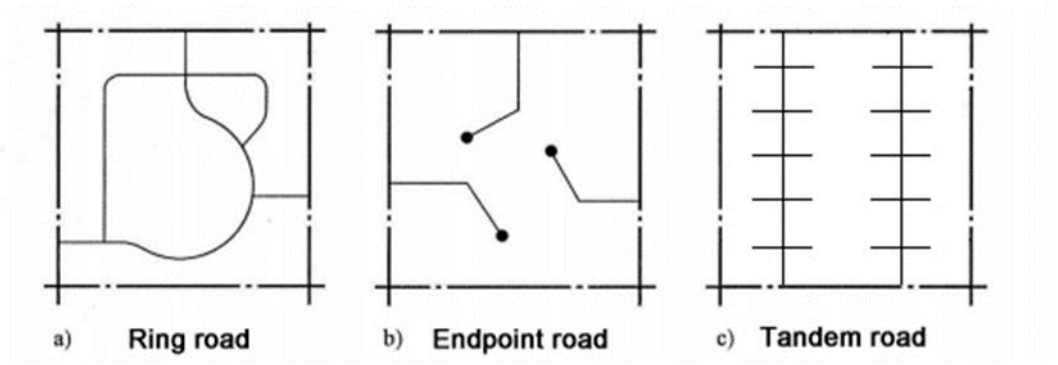

Figure 3.11 The common community types of different road systems

The urban communities, with the rapid development of city, have turned into a huge demand and a series of evolution. A large number of communities have been conducted to meet the large demand and most of them are concerned about the design or construction. Naturally, some unreasonable design will come along and it surely will result into a low utilization, and even the indifference of interpersonal relationships. The accessibility of communities is low and it is sometimes hard to walk from one part to another part within the community. Accessibility generally refers to the ease of transportation from one point to another point. Starting from the perspective of daily transport infrastructure is a measure to the efficient allocation. From the urban planning point of view can be an assessment to deepen the city's public service facilities rationalization and fairness arrangement. This paper will try to analyze how convenient from one part to other parts of the communities.

Analysis by Space syntax

1) Shuiyin Kangting Community

The warmer the line's color is, the higher the integration value will be. Conversely, the lower will be. Therefore, as shown in Figure 3.12, in the northeast of the area, there are 3 roads that have the highest value, which means a high accessibility. The space surrounded by these roads of high integration value will be more convenient to be reached. On the north and west of the community, the integration value is lower, which means its position is relatively remote. The northeast area, are the most dynamic places. The south side of the community is the main entrance. However, its accessibility is not so high. The overall layout comes out a cool color, which may mean a low overall accessibility.

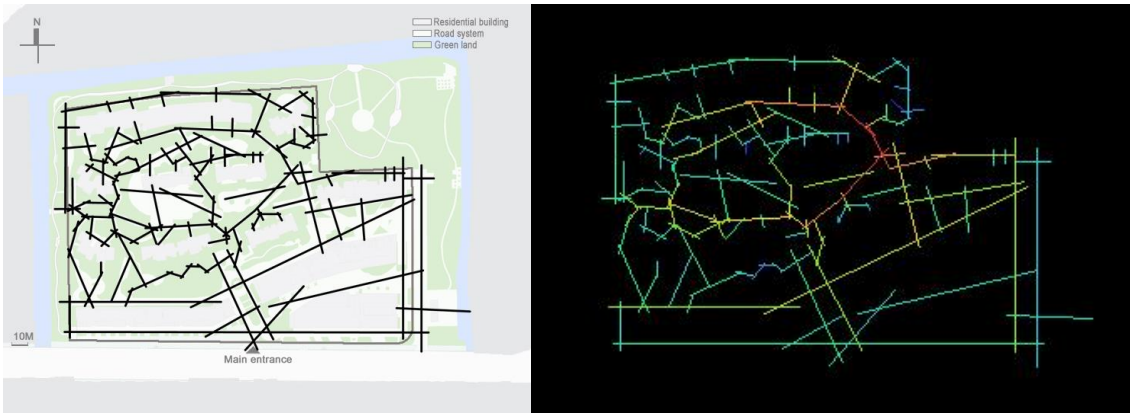

Figure 3.12 The axial drawing and analysis by DepthMap of Shuiyin Kangting Community

2) Yicheng Jiayuan Community

It is apparent from Figure 3.13 that the overall layout is balanced and the axial lines are mainly warm. The ring road system shows a good organization force, especially, at the east and north side of ring road, the integration value is very high. The space surrounded by these roads of high integration value will be more convenient to be reached.

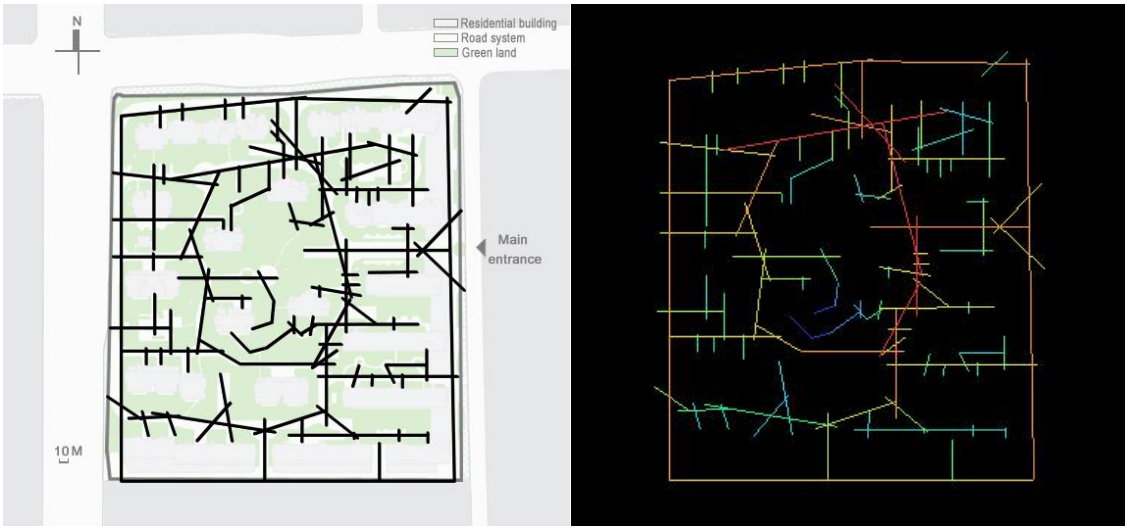

Figure 3.13 The axial drawing and analysis by DepthMap of Yicheng Jiayuan Community

3) Yuandu Xinjing Community

As is shown in Figure 3.14, in the north and east of the area, there are 3 roads that have the highest value, which means a high accessibility. The space surrounded by these roads of high integration value will be more convenient to be reached. However, on the east side of the community, the integration value is relatively lower, which means its position is relatively remote. The accessibility of this part is really not positive.

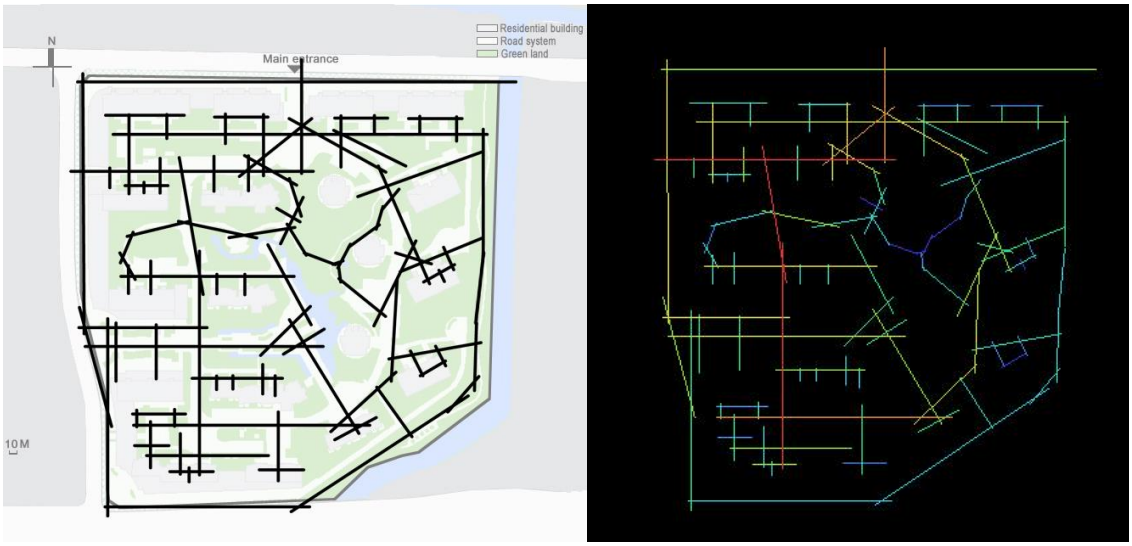

Figure 3.14 The axial drawing and analysis by DepthMap of Yuandu Xinjing Community

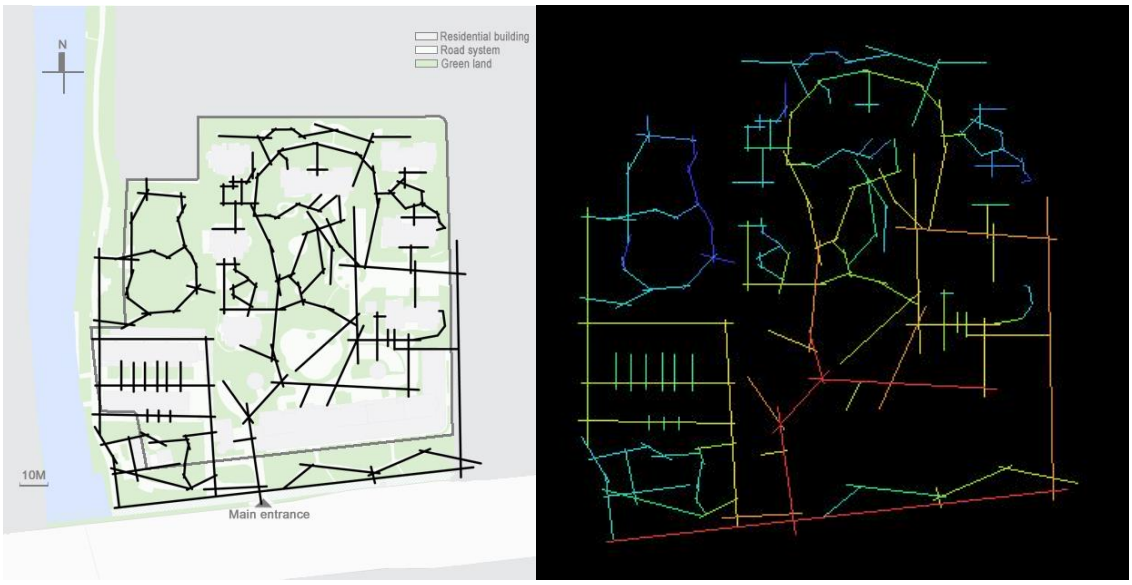

Figure 3.15 The axial drawing and analysis by DepthMap of Ziting Garden Community

4) Ziting Garden Community

As shown in Figure 3.15, in the south side of the area, there are 5 roads that have the highest value, which means a high accessibility. The space surrounded by these roads of high integration value will

be more convenient to be reached. However, in the north part of the community, the color of axial lines is mostly cool. So, the integration value is lower, which means its position is relatively remote and hard to get into. Only the south side of the community, which is the main entrance, is the relatively dynamic places.

Comparative analysis

The comparative analysis is shown in Table 3.2.

In terms of the global integration value, the Yicheng Jiayuan Community has the largest average value of 1.102, which means this overall space has the best accessibility. Next is Yuandu Xinjing Community of 1.096. The accessibility of Ziting Garden Community is the lowest one of 0.614. If just according to the integration value, the residents of Yicheng Jiayuan community will have the best spatial experience, such as convenience and organization force. The residents in Ziting Garden Community may feel it a little remote position. It will be inconvenient to get to there. Obviously, its utilization will be limited.

Table 3.2 The integration value of the urban communities

Community	Shuiyin Kangting	Yicheng Jiayuan	Yuandu Xinjing	Ziting Garden
Global integration value				
Maximum	1.197	1.608	1.659	0.942
Minimum	0.531	0.540	0.714	0.376
Average	0.824	1.102	1.096	0.614
Local integration value				
Maximum	2.523	2.749	2.798	2.236
Minimum	0.333	0.333	0.637	0.333
Average	1.375	1.480	1.520	1.194

In terms of the local integration value, the Yuandu Xinjing Community has the largest average value of 1.520. Next is Yicheng Jiayuan Community of a high integration value 1.480. Its smallest integration value is only 0.333, so this may become the reason that this community don't own the best local integration value. Others are roughly the same as the condition of global integration value.

Conclusion

Integration value determines the accessibility of the space and will affect its utilization. The larger the integration value is, the better the accessibility will be. That means it is more convenient for people to get there. Therefore, some spaces which will be needed by most people should be set in these better accessibility places. In this paper, every urban community has a place whose accessibility is better, thus some public facilities can be set in there. So, setting the more needed space in the better accessibility place is significant.

Ring road system is helpful for organizing the spatial structure. A relatively good ring road system will

easily make the road network orderly and compact. Residents will be easy to get there and be dynamic places. In contrast, the areas will be remote and few residents will get there, which means a low utilization and a waste of public resource.

This paper investigates how Space syntax techniques can help assess the effect of ring road system on the community and social structure. Such techniques are assumed useful in predicting the social structure of the proposed space and in assessing design alternatives. Is it possible to predict that social structure of space using Space syntax techniques? The answer appears to be positive.

Chapter 4.
Analysis of respondents' perceptions about public green spaces based on post-occupancy evaluation

4.1. Basic information of public green spaces

The land is flat, and there is no natural lake or river, only a small artificial pond. Besides, the shape of the campus is regular, mainly planned in the north-south direction. The arbor trees are mainly native species, part of which with stout stems. As illustrated in Figure 4.1, in the main campus, there are teaching buildings, laboratory buildings, a library, dormitories, stadiums, canteens and a gymnasium. Besides, in the east part of Lindong Road, there is a small living area, named Lianjian apartment, with 6 dormitories and a canteen. Due to the continuous construction and change of the campus, this study is of the current status in February 2018, with a total area of 18.86 ha (the main campus area is 16.23 ha, the Lianjian apartment area is 2.63 ha), building coverage ratio of 0.17 and a greening ratio of 49.7%, 9.37 ha.

The greening ratio on Yijin Campus is particularly high. For a better research and analysis, six green spaces have been selected, and numbered from space-1 to 6 as shown in Figure 4. These six green spaces have below common characteristics:

- Publicity: The area of green space need be more than 1000 ㎡, excluding the small ones, which can guarantee that it will become a small central area and carry certain public activities.
- Integrity: Not separated by buildings or other spaces, the area can be a complete space.
- Pausibility: The space need be accessible and reachable, which means one or several paths should be inside, making students' staying, resting and so on possibly.

We comprehensively investigated the distribution and growth situation of plants in six public green spaces on Yijin campus. Although there is basically no exposed land on the ground, only a few people stay in them, some of which even few people walked in or people just passed by in a hurry.

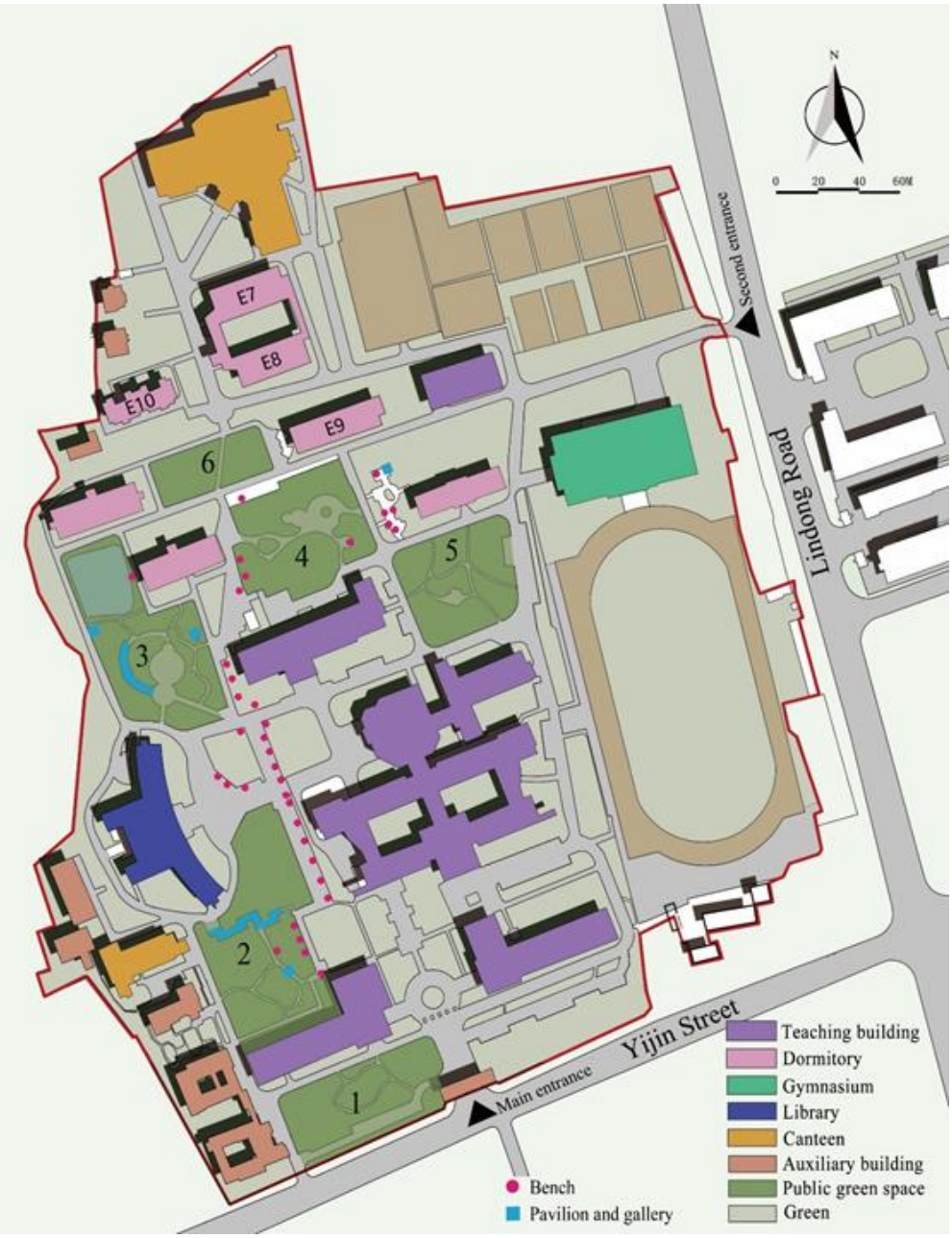

Figure 4.1 The overall layout of Yijin Campus and the infrastructure setting

Figure 4.1 is the overall environment of green Space, and Figure 4.2 The growth situation of plants in green space-1. Space-1 is located on the south side of the west building (teaching building), and students will pass by it after class. The green space covers an area of 3483 ㎡. Shrubs are planted on the west and east sides of the site and the center of the green space is planted with lots of turf. There are few people on the garden road and there are no benches for the entire venue.

Figure 4.2 The overall environment of green Space-1

Figure 4.3 The growth situation of plants in green space-1

Figure 4.4 The overall environment of green Space-2

Figure 4.3 is the overall environment of green Space, and Figure 4.4 The growth situation of plants in green space-2. Space-2, covering an area of 4252 ㎡, is located on the west side of the main teaching building and the south side of the library, which is the only way between the teaching school and the

library. There is a small square on the southwest side, which is relatively open and covered with herbaceous plants, with some groups of landscape. The plants on the east side are very dense and tall, and the trees are old and cultural. In the corridor, students walked by and stopped to take photos, but the stone chairs on the edge and the seats under the corridor were covered with moss, and no one rested or stopped. The daily maintenance was poor.

Figure 4.5 The growth situation of plants in green Space-2

Figure 4.6 The overall environment of green Space-3

Space-3 is located on the north side of the library, where students usually pass through from the library to the dormitory, covering 3963 ㎡. There is a small square, lake, pavilion and gallery. When walking out of the corridor, people can see the small lake, and some stone benches around. Willow and metasequoia trees are planted near the water. At the entrance of the long white corridor, a vine is planted around the pillars. The southeast corner is planted with 17 kinds of plants, including ginkgo biloba. The whole site is rich in plant species, seasonal color change and plant collocation.

Figure 4.7 The overall environment of green Space-4

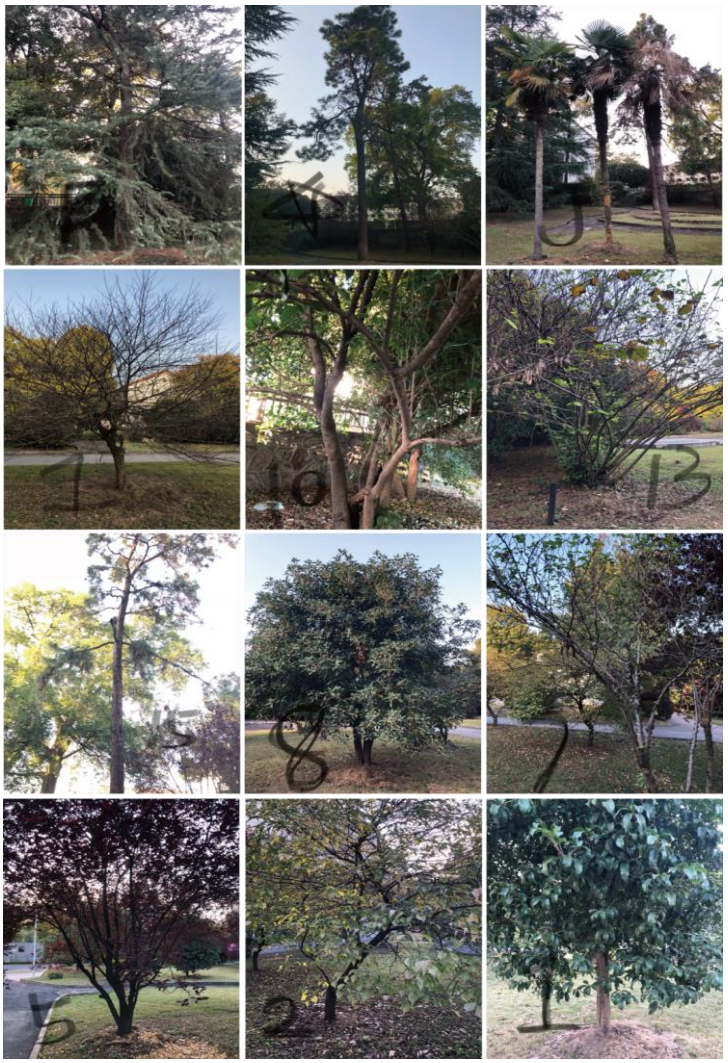

Figure 4.8 The growth situation of plants in green space-4

Space-4 is located on the north side of the experimental building (teaching building). Students will pass by it when they return to dormitory after class in the teaching building. The green area of space-4 is 2878 ㎡ and is divided into 3 parts by paths. 9 kinds of trees, such as sweet-scented, osmanthus trees, and a small number of bushes are mainly planted. The large steps and benches on the north and west sides of the site are used as a rest space for pedestrians, but used by fewer people and only a couple chatting on the bench.

Figure 4.9 The overall environment of green Space-5

Figure 4.10 The growth situation of plants in green space-5

Space-5 is located on the east side of the experimental building (teaching building) and on the north side of the main teaching building. When students return to the dormitory from the teaching building, they will pass by here. The green area is 2859 ㎡. There are tall trees on the side, with 3 kinds of

shrubs and 10 kinds of trees inside (but not many), and some bamboo. The entire plot of plants is layered and diverse in color and covered with vegetation. But there are few people, only passing students, and no places to rest and stop.

Figure 4.11 The overall environment of green Space-6

Figure 4.12 The growth situation of plants in green Space-6

Space-6 is located in the vicinity of the dormitory building E7-8-9-10, which is also the closest green space to the student dormitory. The green area is 1447 ㎡. There are 2 kinds of shrubs on the north side, no other trees and facility and it is dominated by large lawns. Although it is close to the dormitory area, people only pass by instead of staying in, may because of no living facilities, no physical fitness equipment, and no benches to stay. But the field of vision is very open.

Table 4.1 shows the information of six representative green spaces with their positions, area, and the plant composition in each space on Yijin campus. The vegetation of space-1 to 5 is very lush, full of trees, shrubs and herbs, and basically no exposed grounds. Only space-6, had only medium-size shrubs and herbs growing and a very open view of sight. Besides, lush vines were growing in space-2 and 3, entangling the gallery, as shown in Figure 4.4 and Figure 4.5.

Table 4.1 Basic information of the six green spaces (based on data from Zhejiang A&F University)

Space number	Position	Plant composition	Area (㎡)
1	South of West Building	Trees, shrubs, herbs	3483
2	South of the library	Trees, shrubs, herbs, vines	4258
3	North of the library	Trees, shrubs, herbs, vines	3963
4	North of Experimental building	Trees, shrubs, herbs	2878
5	East of Experimental building	Trees, shrubs, herbs	2859
6	West of E9 dormitory	Shrubs, herbs	1447

4.2. Basic information of respondents

In Yijin campus, totally there are three main faculties: Faculty of Economics and Management with 1,565 students, Faculty of Culture and Law with 1,927 students and Faculty of Continuous Education with 430 students, among which, 1,296 students (973 female and 323 male) lived in the main campus, and 2,626 students (1,783 female and 843 male) lived in the Lianjian apartment. As shown in Table 4.2, among the 590 valid face-to-face interview questionnaires collected, males accounted for a minority, only 25.1%, far less than females (74.9%), because of the originally unbalanced male-female ratio of the Yijin campus. Besides, Faculty of Economics and Management and Faculty of Culture and Law have a large number of female students. Regarding the growth situation of respondents, the proportion of growing up in rural areas was the largest, reaching 41.5%, followed by students who grew up in urban areas, accounting for nearly one-third (33.1%). The students growing up in towns and urban-rural areas accounted for 13.6% and 11.9% respectively. As far as the student grade was concerned, the proportions were also relatively greatly different. The Grade 1 and Grade 2 students accounted for more than 80% of the total number of respondents, 40.5% and 41% respectively. The proportion of Grade 3 ratio (9.5%) was slightly more than Grade 4's ratio (4.1%), which was similar to Master students. 256 students from the Faculty of Economics and Management, 301 students from the Faculty of Culture and Law and 33 from the Faculty of Continuous Education received our investigation.

Among the survey, 28.4% of respondents lived in dormitories (E7-8-9-10) on the main campus and most of them (71.4%) lived in the Lianjian apartment. Besides, it was worth mentioning that one of the questionnaires is answered by an off-campus student (Living off campus was not encouraged by the university).

Regarding the question "how much time averagely in each day you will take a walk around on campus, excluding the time spent indoors, but including the time spent on the way to classroom or otherwhere", what was shocking was that 18.5% of the respondents spent an average of less than 10 minutes on campus, while the highest number is 10-30 minutes (63.9%). It was obvious that very little time was

spent on enjoying the green spaces. Only 17.6% of students, on average more than half an hour a day, would spend on moving around on campus. From this result, students' actual usage condition of green space was worrying us, and their outdoor time was significantly less. Many students spent most time on staying in their dormitories and classrooms, and as a result, the time of contact with nature or activities in green spaces was greatly reduced, thus resulting in a low utilization of green spaces. According to our observations, many students rushed on the road, only a few students sitting on a bench or a gallery nearby or in a green space. What was the cause of this phenomenon? What was the student's perception of green spaces? What was the student's satisfaction with the green space? We set up more questions to investigate.

Table 4.2. Basic information of respondents

Item	Group	Number	Proportion (%)
Gender	Male	148	25.1
	Female	442	74.9
Growth situation	Rural area	245	41.5
	Small town	80	13.6
	Urban area	195	33.1
	Urban suburb	70	11.9
Grade	Grade 1	239	40.5
	Grade 2	242	41.0
	Grade 3	56	9.5
	Grade 4	24	4.1
	Master	29	4.9
Faculty	Economy and management	256	43.4
	Culture and law	301	51.0
	Continuous education	33	5.6
Dormitory	E7	41	6.9
	E8	49	8.3
	E9	33	5.6
	E10	45	7.6
	Lianjian apartment	421	71.4
	Off campus	1	0.2
Frequency of moving round on campus	Nearly no (0-10 mins)	109	18.5
	Sometimes (10-30 mins)	377	63.9
	Often (>30 mins)	104	17.6

4.3. Evaluation of respondents about public green spaces

In order to investigate the usage of the six green spaces on Yijin Campus, we investigated following aspects: satisfaction to them (Figure 4.13), including plant collocation, seasonal color change, settings for rest, safety and overall satisfaction, demands of students (Figure 4.17), and usage periods (Figure 4.39). There are five points in total: one point means very dissatisfied, two points dissatisfied, three points fairly satisfied, four points satisfied and five points very satisfied.

4.3.1. Satisfactions of the public green spaces

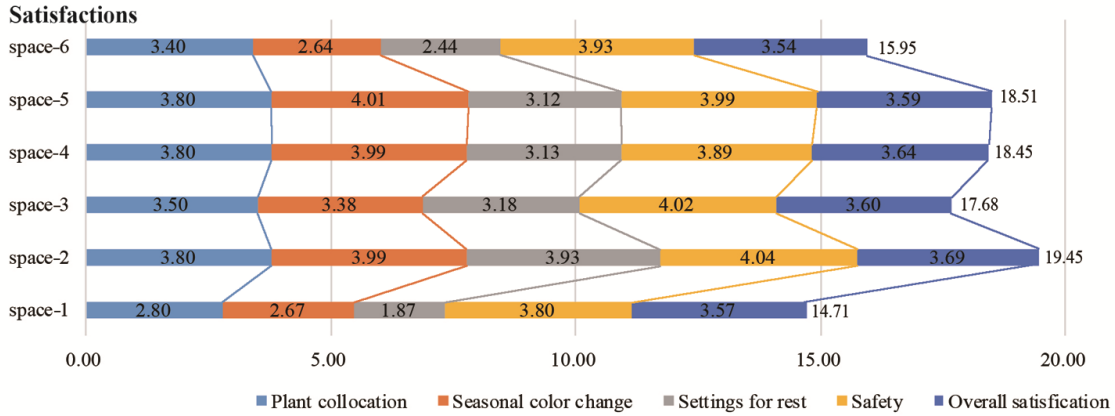

Figure 4.13 Satisfactions to the six public green spaces (n=590).

In terms of plant collocation, as shown in Figure 4.13, space-1, respondents had the lowest satisfaction with this, only 2.8 points, probably because the most striking was all of the tall and dense trees, preventing from the sun. At the same time, the evaluation of space-6 was also relatively low, only one kind of shrub and grass in the site, appearing a bit monotonous. Similarly, regarding seasonal color change, space-6 and 1 also had the lowest evaluation. Conversely, spaces-5, 4 and 2 were rich with plants such as maple trees that change color with the seasons, so the respondents had better evaluation. As for the settings for rest, including benches, pavilions and galleries, space-1 was unsatisfactory, only 1.87 points, as can be seen from the Figure 4.13, no any rest facilities, only plants and paths, which certainly resulted into a bad remaining. Next is space-6, satisfaction 2.44, the same situation, no rest facilities. Space-4 and 5 had a very similar and general satisfaction, 3.13 and 3.12. Although there were no rest facilities in space-5 but nearby of it five benches and one pavilion remaining, space-4 had several benches. Inside green space-3, there were an artificial pond, pavilions, galleries and benches, therefore students also showed a slightly higher recognition than space-4 and 5. Space-2 is on the south of the library, where a lot of benches, a pavilion and a gallery full of vines, the satisfaction was relatively high (4.04 points), which had the most rest facilities and environmental culture. However, after on-site observation, we found that the seats in the gallery were covered with moss, many students passing by, but few sitting down and having a rest. This should also be a factor that affected responds' satisfaction.

Regarding the perception of safety, the difference between green spaces was not obvious, space-2 and 3 got the highest evaluation, and space-1 was the relatively lowest of 3.80 points, which meant the security of the entire campus was really satisfying.

For the overall satisfaction, in Figure 4.13, the difference between the six green spaces is not large, the score of space-2 is relatively high, 3.69 points, and the space-6 is the lowest, 3.54 points. The scores of the remaining four spaces had a similar satisfaction, 3.57, 3.60, 3.64, and 3.59 respectively. In these impacts, space-2 got the highest total evaluation of 19.45, and space-5 and 4 got a similar

evaluation, which are all beside of the Experimental building. The lowest evaluated space-1, because of monotonous plants species, no seasonal color change and settings for rest, undoubtedly got a worst satisfactory.

4.3.1.1. The influence of gender to the satisfaction of public green spaces

According to the different gender, plant collocation, seasonal color change, settings for rest, safety and overall satisfaction were summarized. As shown in Figure 4.14, the differences of genders, male (148 persons) and female (442 persons), had very limited effect on the perceptions of green space, such as the plant collocation, seasonal color change, settings for rest, overall satisfaction averagely in the sample six public green spaces, displaying a same trend of evaluation. In all aspects of perceptions, the average male satisfaction was a very little higher than female. Only regarding safety, 4.03, is slightly higher than female satisfaction. Therefore, in overall satisfaction, 3.65 points for men was 3.60 points higher than women.

The following figures were a series of analysis about the plant collocation, seasonal changes, rest facilities, safety, overall satisfaction and average satisfaction of the six green spaces, divided into by men's and women's, and compared the effects of different gender on these aspects in detail. In Figure 4.14, the effects of gender on the plant collocation, seasonal changes and rest facilities of Space-1 to 6 were minimal. However, women's safety against space-4 was significantly lower than that of men, which may be due to the obvious height difference between the north side of the plot and the road surface, likely a safe dead angle. Space-6 was also a very flat grassland close to the dormitory area, which men thought was very safe, even ranking first in the six plots. But women obviously didn't think so.

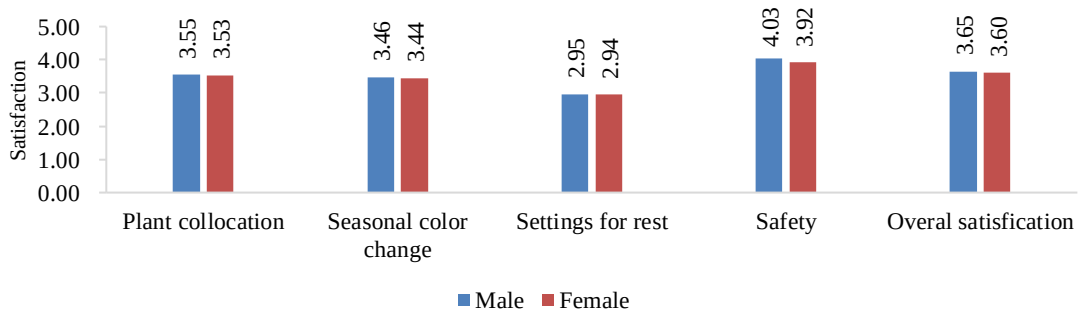

Figure 4.14 The influence of different gender to the perceptions of public green spaces (n=590).

Use the analysis of variance (one-way analysis of variance) to study the influence of different genders to the four items of collocation space-average, color space-average, settings space-average, and safety space-average. As can be seen from Table 4.3: different genders will not show significance for a total of 3 items of collocation space-average, color space-average, and settings space-average ($p > 0.05$), which means that different gender samples have all showed consistency, and there was no difference. In addition, gender samples showed significant significance for a total of safety space-average ($p < 0.05$), which means that different gender samples have differences in safety space-average. Specific

analysis shows that gender showed a 0.05 level significance (f = 5.851, p = 0.016) for the safety space-average, and the specific contrast difference shows that the average value of 1.0 (4.03) will be significantly higher than the average value of 2.0 (3.91).

Table 4.3 ANOVA of the influence of gender to the average satisfaction of 6 public green spaces.

ANOVA of gender								
	SSB	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
collocation Space-average	0.022	80.277	1	588	0.022	0.137	0.158	0.691
color Space-average	0.067	93.708	1	588	0.067	0.159	0.42	0.517
Settings Space-average	0.003	110.535	1	588	0.003	0.188	0.016	0.899
Safety Space-average	1.386	139.284	1	588	1.386	0.237	5.851	0.016*
* p<0.05 ** p<0.01								

4.3.1.2. The influence of growth situation to the satisfaction of public green spaces

The survey also proved that different growth situations had little impact on different greening perceptions. As shown in Figure 4.15, in terms of plant collocation, students living in rural areas thought that the average greening satisfaction of the campus was 3.59, which was slightly higher than the other three environments: small towns (3.51), urban areas (3.50) and suburban junctions (3.49). In terms of seasonal color changes, only those who grew up in urban areas were slightly lower than those in the other three environments. Similarly, there were only very limited differences in perceptions of settings for rest, safety and overall satisfaction, but the overall trend was consistent. Therefore, it reflects that with the development of China's 40 years urbanization, the awareness of students growing up in different situation are gradually approaching each other. Besides, parts of the gap between rural and urban areas have been reduced (Guan et al. 2018). Part rural areas are no longer in the traditional sense of the mountains, or surrounded by endless greenery. Conversely, the urban areas are not some imagined icy cities surrounded by reinforced concrete. It should be admitted that the difference in growth situations doesn't lead to a great impact on the perception of students to green spaces.

Figure 4.15 below detailed the respondents who have different growth environments and evaluate the satisfaction of the six green spaces, which shows that different genders have minimal impact on plant collocation, seasonal color changes and rest facilities, whose trends were consistent. However, in different growth environments, the perception of security was not exactly the same. Respondents who grew up in small towns were more satisfied with the safety of green spaces everywhere, compared with the students from other three environments. The satisfaction of each place was around 3.95. Then the respondents who grew up in the other three environments have large fluctuations, which in the urban suburbs were particularly obvious.

As can be seen from Table 4.4: different growth situation will not show significance for a total of 4 items of collocation space-average, color space-average, settings space-average and safety space-average (p> 0.05), which means that different growth situation samples have all showed consistency, and there was no difference.

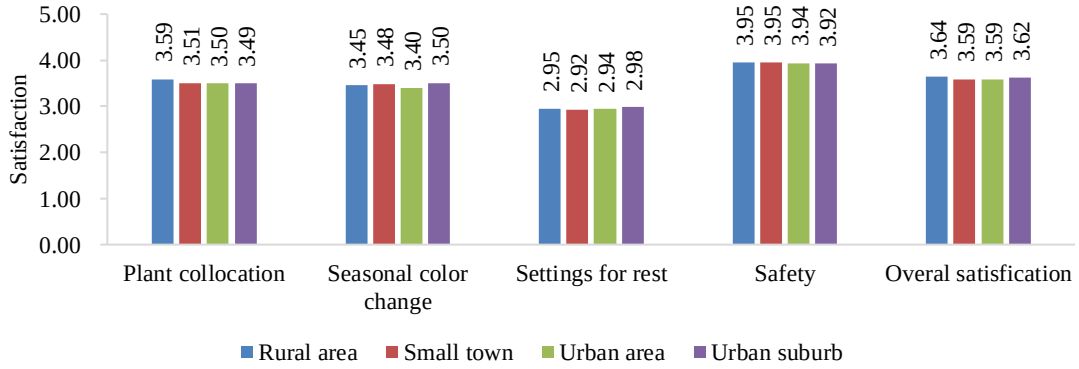

Figure 4.15 The influence of different growth situation to the perceptions of public green spaces.

Table 4.4 ANOVA of the influence of growth situation to the average satisfaction of 6 public green spaces.

ANOVA of growth situation								
	SSB	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
collocation Space-average	1.029	79.269	3	586	0.343	0.135	2.537	0.056
color Space-average	0.695	93.08	3	586	0.232	0.159	1.458	0.225
Settings Space-average	0.171	110.367	3	586	0.057	0.188	0.302	0.824
Safety Space-average	0.764	139.906	3	586	0.255	0.239	1.067	0.362

* p<0.05 ** p<0.01

4.3.1.3. The influence of frequency of moving around on campus to the satisfaction of public green spaces

According to the survey results (Figure 4.16), the frequency of moving around on campus did have a certain impact on the evaluation of campus space quality. On average, students who walked around the campus occasionally（sometimes, 10-30 mins per day）had the lowest overall satisfaction (3.59), followed by students who barely went to campus (3.63). The best evaluation was from students who moved around on campus very often (3.67). They spent averagely more than half an hour per day outside on campus. Because of being outdoors for a relatively long time, they knew more about the public green spaces. After deep understanding, they could give higher evaluations, which also can reflect that the quality of Yijin campus green space is relatively good and worth being enjoyed.

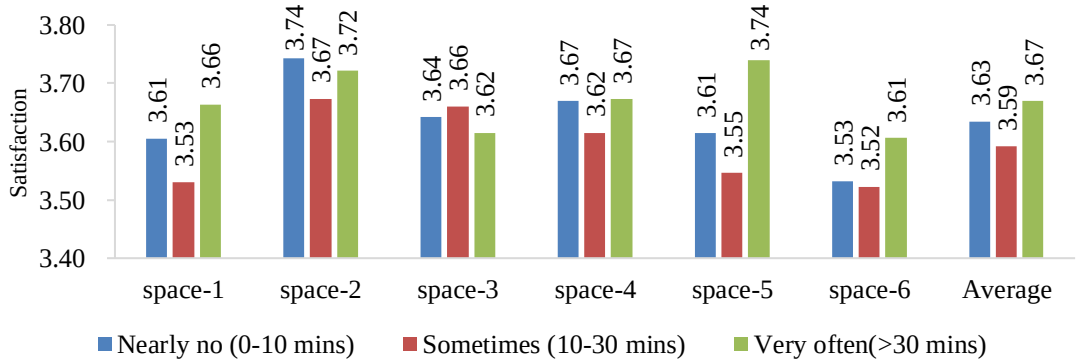

Figure 4.16 The influence of frequency of moving around on campus to the perceptions of public green spaces (n=590)

Table 4.5 ANOVA of the influence of frequency of moving around on campus to the average satisfaction of 6 public green spaces.

ANOVA of Frequency of moving around the campus								
	SSB	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
collocation Space-average	0.391	79.908	2	587	0.195	0.136	1.436	0.239
color Space-average	0.376	93.399	2	587	0.188	0.159	1.181	0.308
Settings Space-average	0.408	110.13	2	587	0.204	0.188	1.087	0.338
Safety Space-average	1.394	139.276	2	587	0.697	0.237	2.937	0.054
* p<0.05 ** p<0.01								

Use the analysis of variance (one-way analysis of variance) to study the differences of frequency of visiting the campus for the four items of collocation space-average, color space-average, settings space-average, and safety space-average. As can be seen from Table 4.5 above: respondents with different frequency of visiting the campus samples will not show obvious significance of satisfaction of average collocation space, color space, settings space, and safety space ($p > 0.05$), which means that different frequency of visiting the campus showed consistency for collocation space-average, color space-average, settings space-average, safety space-average, and there was no difference.

4.3.2. Demands of the public green spaces

"What do you want the following green spaces to meet your needs?" In this question, respondents could choose multiple answers. As can be seen from the right side of Figure 4.17, reading or resting, enjoying the scenery, and chatting or walking are the averagely most three needed functions according to the respondents (The total responds number is 590). Among them, chatting or walking has a clearly highest score, which was needed by 356 respondents, slightly more than 60%, showing the most important demand.

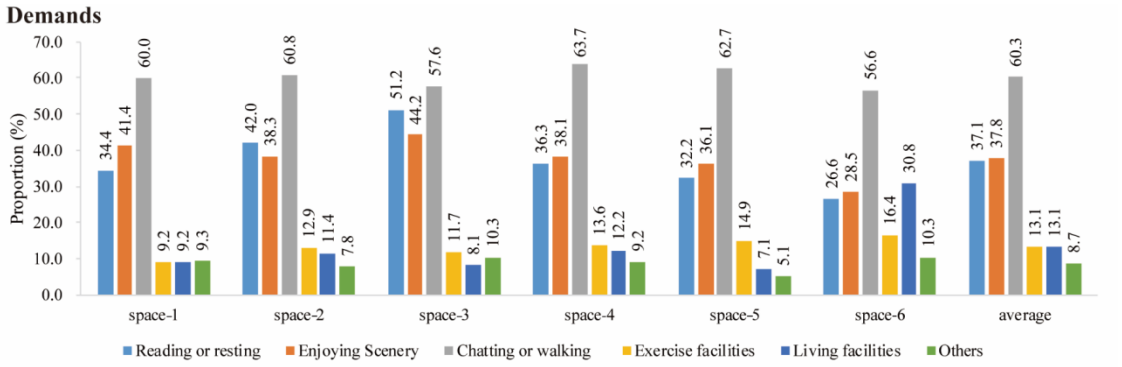

Figure 4.17 The proportion of various demands to the six public green spaces (from space-1 to 6, n=590).

Based on the existing landscape status, the second demand was to enjoy the scenery, which was needed by an average of 223 respondents, accounting for 37.8%. Besides, this demand was most evident in space-3, in which 44.2% persons felt that they needed to sit down and enjoy the scenery. The following was space-1, a relatively high demand but with a low satisfaction of plant species and color richness (Figure 4.13), lower than the average level. Therefore, improving the landscape level and richness is

an urgent problem to be solved. In space-2, 38.3% persons, and in space-4, 38.1% persons had the similar demand, close to the average demand of 37.8%, which represented the average demand for students to enjoy the scenery of public green spaces. The lowest demand for viewing was space-5 and space-6, especially space-6, only 168 (28.5%) persons, indicating that its landscape status was not particularly satisfactory, or its space location wasn't appreciated by students. The third demand was reading or resting, as shown in the right side of Figure 4.17, chose by 219 people averagely, accounting for 37.1%. Regarding each green space, the first was space-3, 302 (51.2%) persons, which meant more than half of respondents wanted to read or rest there. Close to the library and the experimental building, it should be a reason. Followed was space-2, an advantage of closing to the library and teaching building, chose by 248 respondents. Next, followed by space-4 (36.3%), space-1 (34.4%), and space-5 (32.2%), nearly one-third of people thought it necessary. The least, indicated in Figure 4.17, was still space-6, only 157 (26.6%) of students felt that they need read or rest in this green space, which was closest to the dormitory area. In terms of the very similar fourth and fifth demand, living facilities like drying racks, exercise facilities like single-parallel bars, were both most needed by respondents to space-6.

4.3.2.1. The influence of gender to the demand of public green spaces

Figure 4.18 show the effect of gender on demand of the six public green spaces and the average of them, including 148 for men and 442 for women. In space-1, men's and women's needs for reading or rest were different. Among male respondents (148), 38.5% of them thought that this function needed to be set, which was significantly higher than that of female respondents (442). 33.0%. In space-2, women's demand for reading or rest and chatting and walking was 44.3% and 62.7%, respectively, which was significantly higher than males' 35.1% and 55.4%. As for the first three needs of space-3, the proportion of women was greater than that of men, and women had a higher demand for reading and rest, enjoying the scenery, and chatting or walking. The demand of space-4 to enjoy scenery and chat and walks was also greater for women than for men. Therefore, in the space-1 to 4 around the teaching building, the most prominent thing was the female's chatting and walking function. It is recommended to carry out corresponding transformation and daily maintenance.

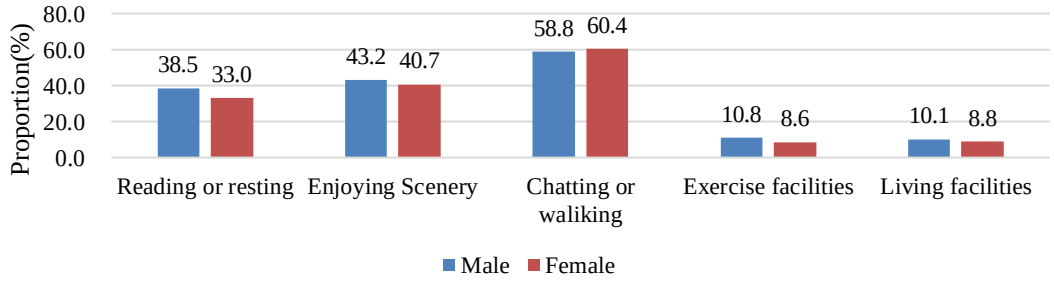

Figure 4.18 The proportion of various demands by different gender to public green space-1.

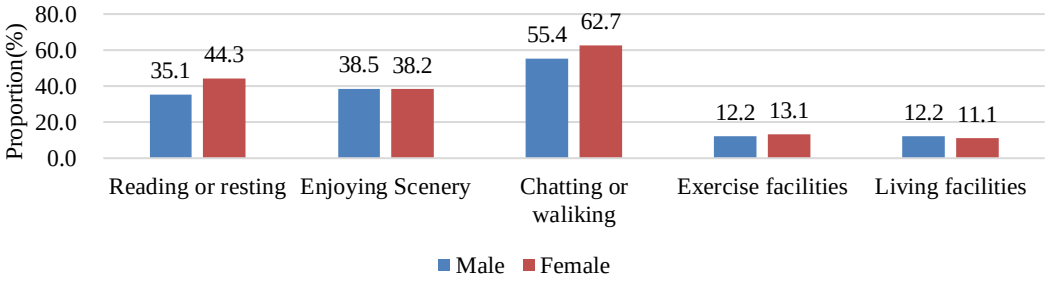

Figure 4.19 The proportion of various demands by different gender to public green space-2.

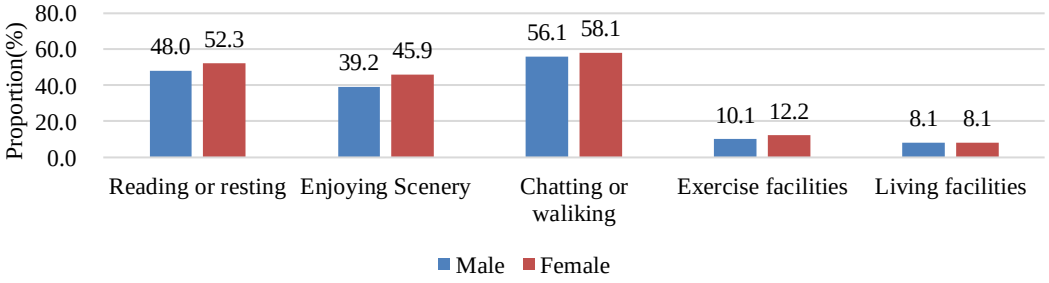

Figure 4.20 The proportion of various demands by different gender to public green space-3

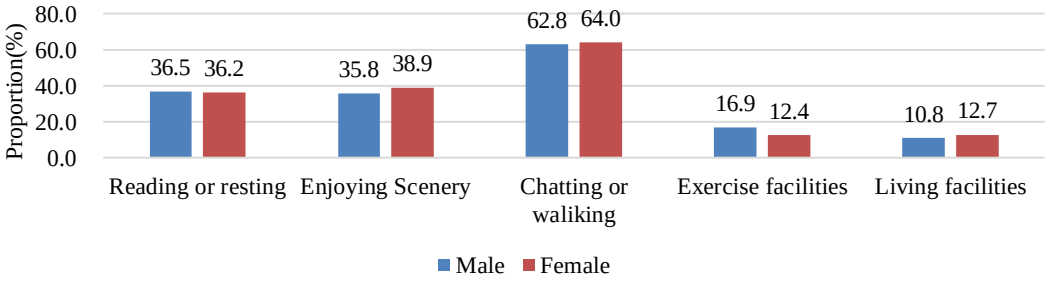

Figure 4.21 The proportion of various demands by different gender to public green space-4

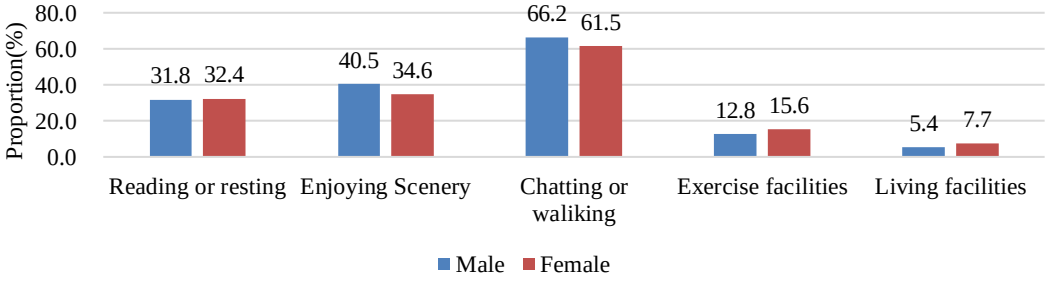

Figure 4.22 The proportion of various demands by different gender to public green space-5

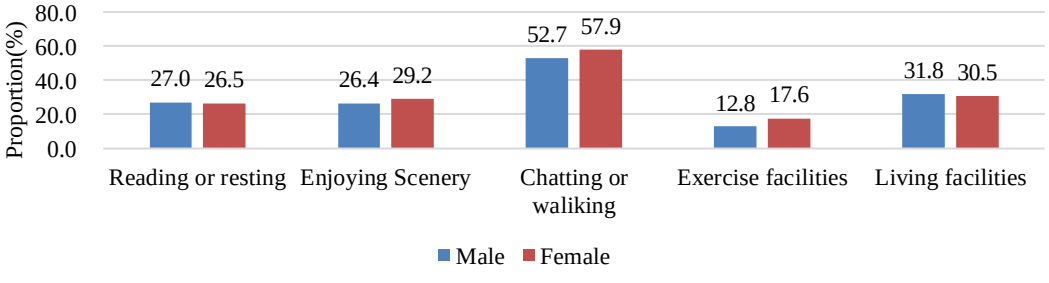

Figure 4.23 The proportion of various demands by different gender to public green space-6

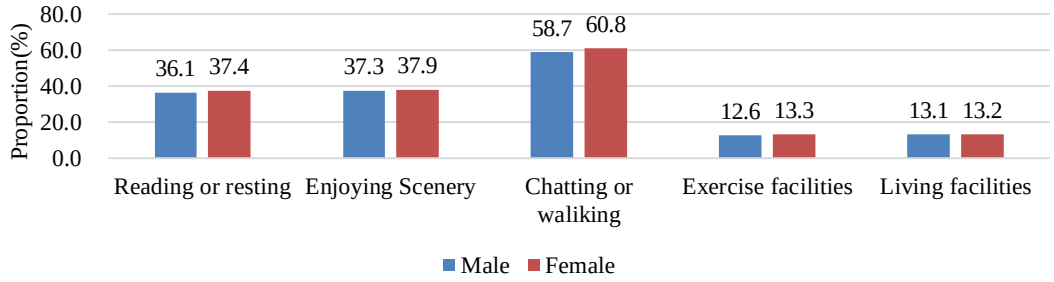

Figure 4.24 The average proportion of various demands by different gender to six public green spaces (from space-1 to 6).

Table 4.6 ANOVA of the influence of gender to the demands of 6 public green spaces.

ANOVA of gender								
Space and demands	**SSB**	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
1-Reading or resting	0.333	132.821	1	588	0.333	0.226	1.475	0.225
1-Enjoying Scenery	0.058	143.204	1	588	0.058	0.244	0.239	0.625
1-Chatting or walking	0.022	141.777	1	588	0.022	0.241	0.09	0.765
1-Exercise facilities	0.054	49.003	1	588	0.054	0.083	0.652	0.42
1-Living facilities	0.019	49.039	1	588	0.019	0.083	0.229	0.633
1-Others	0.008	50.677	1	588	0.008	0.086	0.095	0.758
2-Reading or resting	0.94	142.816	1	588	0.94	0.243	3.871	0.05*
2-Enjoying Scenery	0.001	139.43	1	588	0.001	0.237	0.004	0.952
2-Chatting or walking	0.549	140.224	1	588	0.549	0.238	2.303	0.13
2-Exercise facilities	0.01	66.2	1	588	0.01	0.113	0.091	0.763
2-Living facilities	0.013	59.379	1	588	0.013	0.101	0.127	0.722
2-Others	0.044	43.212	1	588	0.044	0.073	0.6	0.439
3-Reading or resting	0.204	147.213	1	588	0.204	0.25	0.815	0.367
3-Enjoying Scenery	0.503	145.037	1	588	0.503	0.247	2.041	0.154
3-Chatting or walking	0.037	144.181	1	588	0.037	0.245	0.153	0.696
3-Exercise facilities	0.048	60.882	1	588	0.048	0.104	0.464	0.496
3-Living facilities	0	44.095	1	588	0	0.075	0	0.989
3-Others	0.004	54.689	1	588	0.004	0.093	0.047	0.828
4-Reading or resting	0	136.653	1	588	0	0.232	0	0.989
4-Enjoying Scenery	0.107	139.088	1	588	0.107	0.237	0.451	0.502
4-Chatting or walking	0.01	136.642	1	588	0.01	0.232	0.044	0.833
4-Exercise facilities	0.219	68.933	1	588	0.219	0.117	1.872	0.172
4-Living facilities	0.038	63.175	1	588	0.038	0.107	0.357	0.551
4-Others	0.002	49.056	1	588	0.002	0.083	0.022	0.881
5-Reading or resting	0.007	129.16	1	588	0.007	0.22	0.034	0.853
5-Enjoying Scenery	0.389	135.714	1	588	0.389	0.231	1.686	0.195
5-Chatting or walking	0.267	137.952	1	588	0.267	0.235	1.137	0.287
5-Exercise facilities	0.085	74.789	1	588	0.085	0.127	0.67	0.413
5-Living facilities	0.058	38.952	1	588	0.058	0.066	0.875	0.35
5-Others	0.002	28.472	1	588	0.002	0.048	0.051	0.821
6-Reading or resting	0.001	115.687	1	588	0.001	0.197	0.006	0.938
6-Enjoying Scenery	0.089	120.074	1	588	0.089	0.204	0.436	0.509

6-Chatting or walking	0.276	144.777	1	588	0.276	0.246	1.121	0.29
6-Exercise facilities	0.256	80.796	1	588	0.256	0.137	1.866	0.172
6-Living facilities	0.016	125.841	1	588	0.016	0.214	0.076	0.782
6-Others	0.01	63.048	1	588	0.01	0.107	0.093	0.76
* p<0.05 ** p<0.01								

The summary of Table 4.6 shows that different gender samples have no obvious influence on the space-1-reading or resting, 1-enjoying scenery, 1-chatting or walking, 1-exercise facilities, 1-living facilities, 1-others, 2-enjoying scenery, and son on, a total of 35 items. Except the gender sample for 2-reading or resting, a significant difference was found. Specific analysis shows that gender showed a 0.05 level significance ($f = 3.871$, $p = 0.050$) for space-2-reading or resting, and the specific contrast difference shows that the average value of 1.0 (0.35) will be significantly lower than the average value of 2.0 (0.44).

4.3.2.2. The influence of growth situation to the demand of public green spaces

Figure 4.25 show the effect of growth situation on demand of the six public green spaces and the average of them, including 245 students from rural area, 80 students from small town, 195 students from urban area and 70 from urban suburb.

Space-1 shows the greatest demand for chatting and walking, no matter which growing environment, especially from the urban suburb, 67.9% thought it was needed. The second was to enjoy scenery, and the largest demand was from students in urban area, accounting for 46.8%. From space-2, closing to the teaching building and library, we can see that the two functions with the highest demand, chatting or walking and reading or resting, were needed by students in small towns. Space-3 and 4 were also the same as space-2, whose largest two demanding were chatting or walking and reading or resting, which may be related to the proximity to the teaching building. And students were used to going through these 3 green spaces before and after class. Because of chatting or walking and reading or resting, these 2 features became much more important. At the same time, students who grew up in small towns have more obvious needs for chatting and walking. For space-5 and 6, the most important function for students was chatting or walking and enjoying scenery, especially space-6, nearest public green space from students' dormitories, whose largest demand of chatting or walking was also most needed by students from a small town.

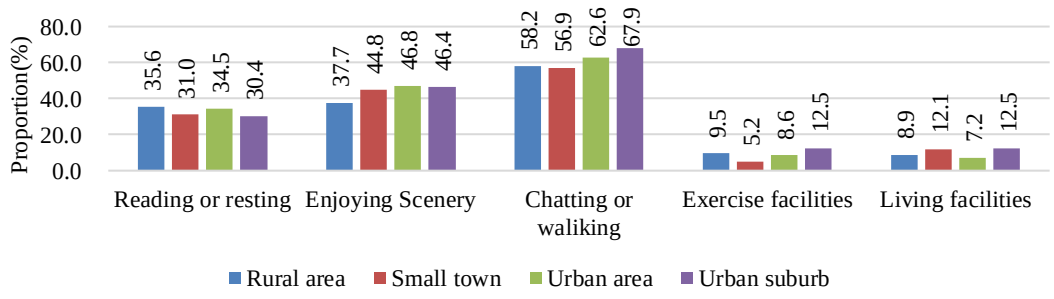

Figure 4.25 The proportion of various demands by different growth situation to public green space-1

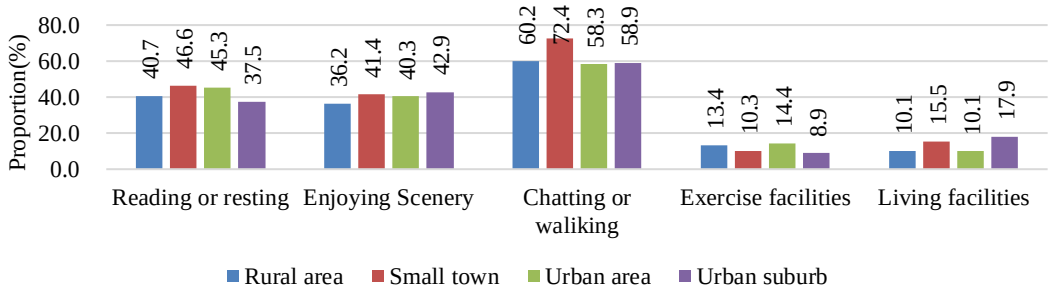

Figure 4.26 The proportion of various demands by different growth situation to public green space-2

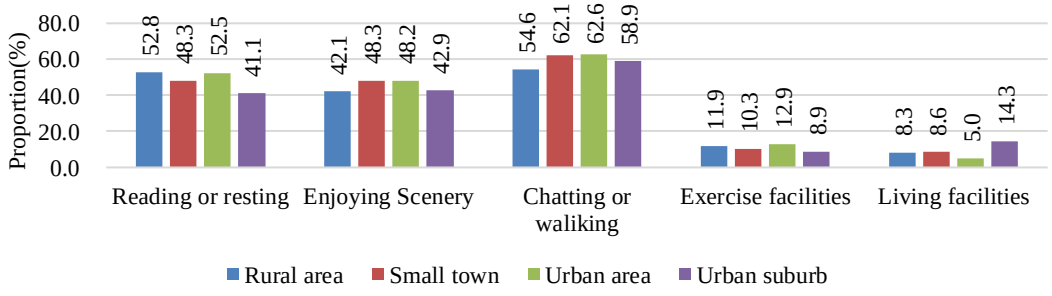

Figure 4.27 The proportion of various demands by different growth situation to public green space-3

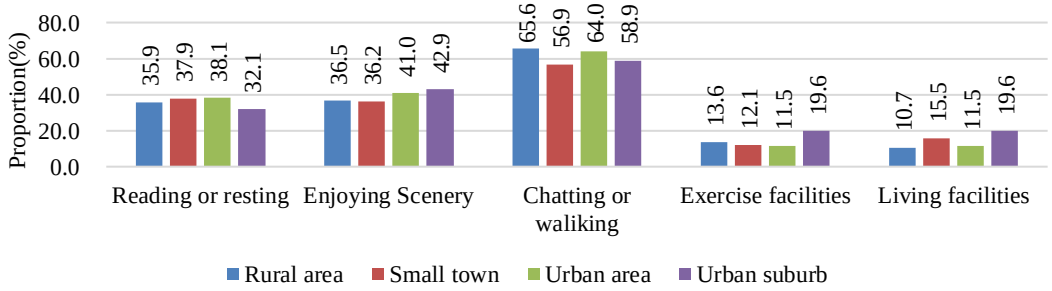

Figure 4.28 The proportion of various demands by different growth situation to public green space-4

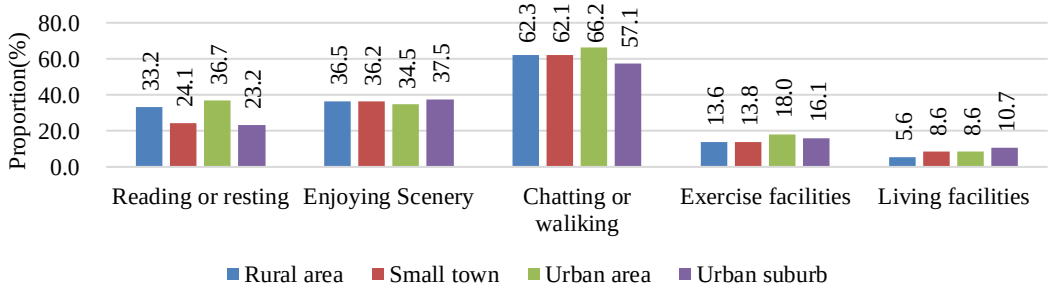

Figure 4.29 The proportion of various demands by different growth situation to public green space-5

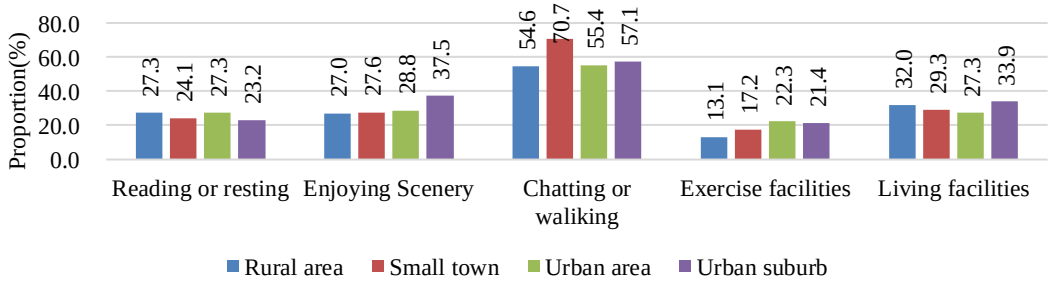

Figure 4.30 The proportion of various demands by different growth situation to public green space-6

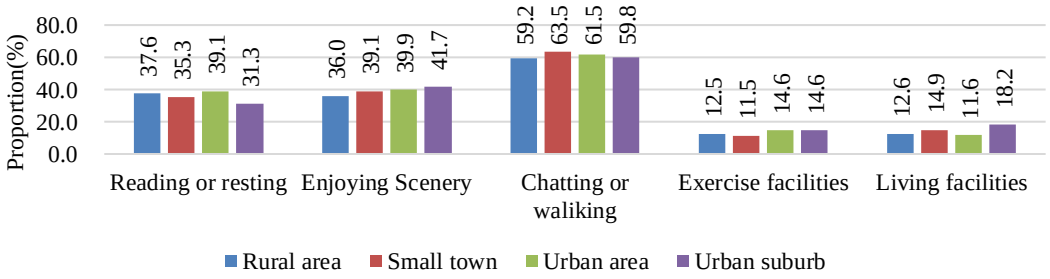

Figure 4.31 The average proportion of various demands by different growth situation to six public green spaces (from space-1-6).

The summary of one-way analysis of variance (ANOVA) shows that different growth situations have no obvious influence on the space-1-reading or resting, 1-enjoying scenery, 1-chatting or walking, 1-exercise facilities, 1-living facilities, 1-others, 2-enjoying scenery, and son on, a total of 36 items.

4.3.2.3. The influence of frequency of moving around on campus to the demand of public green spaces

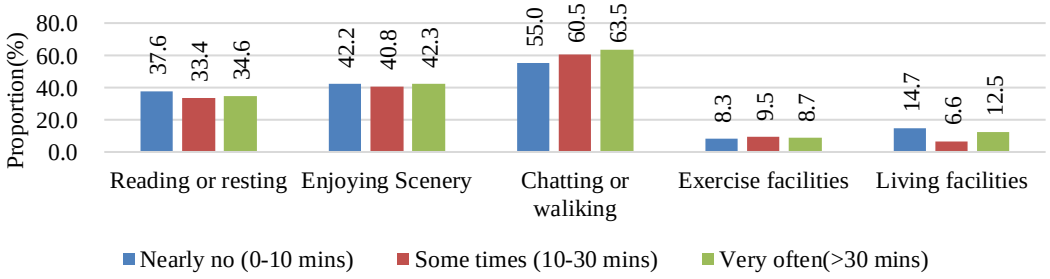

Figure 4.32 The proportion of various demands by different frequency of moving around on campus to public green space-1

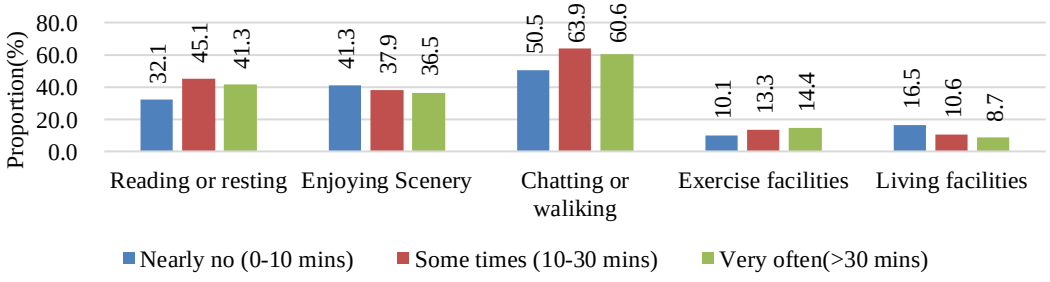

Figure 4.33 The proportion of various demands by different frequency of moving around on campus to public green space-2.

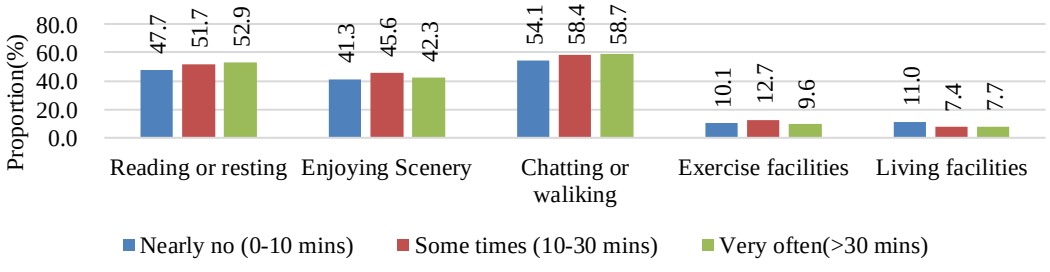

Figure 4.34 The proportion of various demands by different frequency of moving around on campus to public green space-3

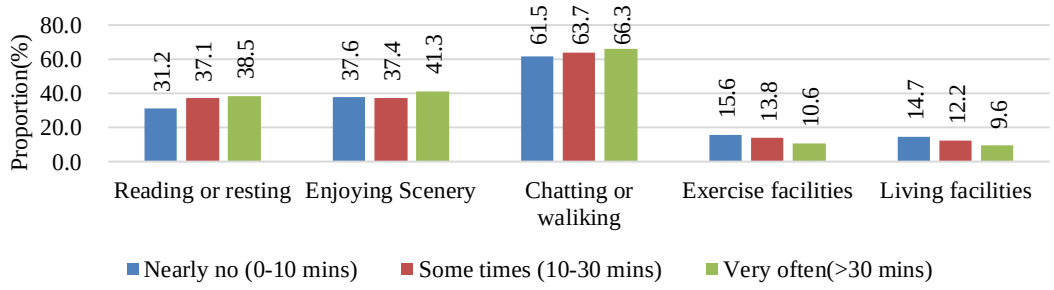

Figure 4.35 The proportion of various demands by different frequency of moving around on campus to public green space-4

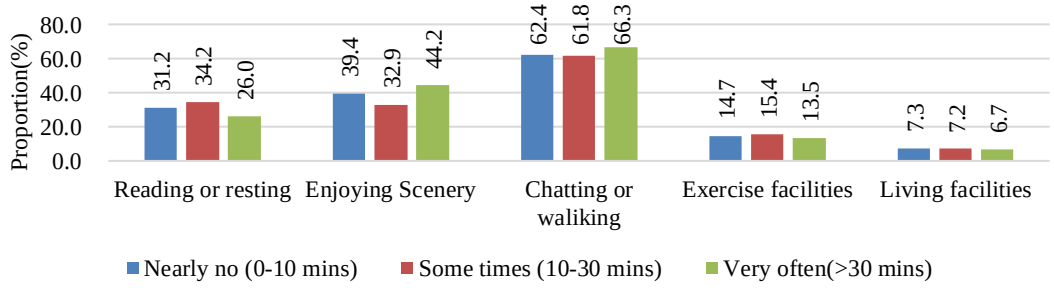

Figure 4.36 The proportion of various demands by different frequency of moving around on campus to public green space-5

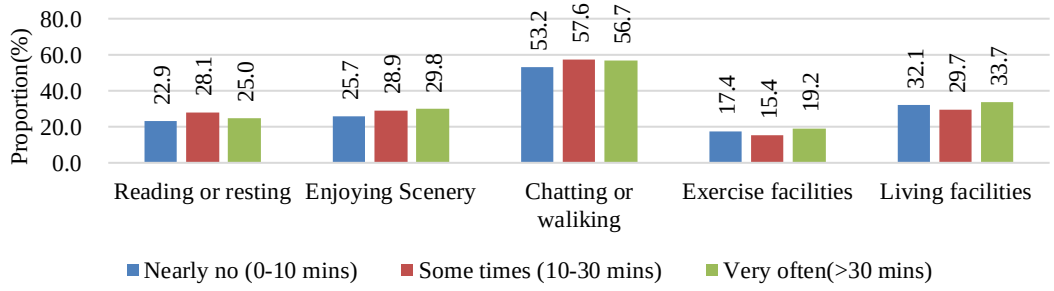

Figure 4.37 The proportion of various demands by different frequency of moving around on campus to public green space-6

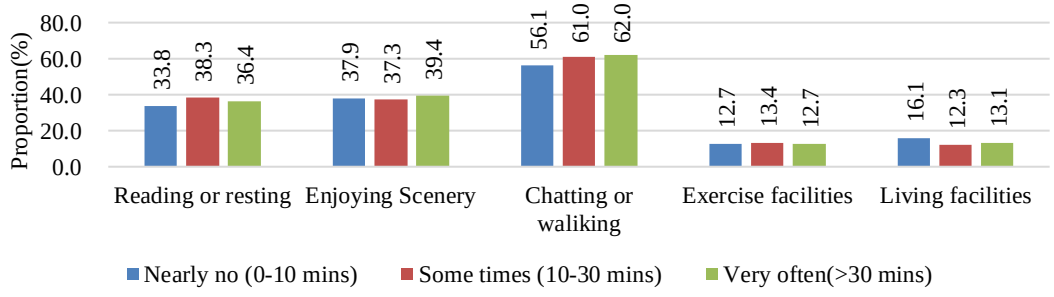

Figure 4.38 The average proportion of various demands by different frequency of moving around on campus to six public green spaces (from space-1-6)

Use the analysis of variance (one-way analysis of variance) to study the differences of frequency of moving around on campus to the different demands of 6 public green spaces. As can be seen from Table 4.7, the space- 1-reading or resting, 1-enjoying scenery, 1-chatting or walking, 1-exercise facilities, 1-others, 2-enjoying scenery, and son on, a total of 34 items showed no significant

differences, except the space-1-living facilities and 2-chatting or walking.

Table 4.7 ANOVA of the influence of frequency of moving around on campus to the different demands of 6 public green spaces.

ANOVA of frequency of moving around on campus								
Space and demands	**SSB**	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
1-Reading or resting	0.149	133.005	2	587	0.075	0.227	0.329	0.72
1-Enjoying Scenery	0.051	143.211	2	587	0.026	0.244	0.105	0.9
1-Chatting or walking	0.507	141.291	2	587	0.254	0.241	1.054	0.349
1-Exercise facilities	0.017	49.04	2	587	0.009	0.084	0.103	0.902
1-Living facilities	0.689	48.369	2	587	0.345	0.082	4.181	0.016*
1-Others	0.286	50.398	2	587	0.143	0.086	1.668	0.19
2-Reading or resting	1.431	142.325	2	587	0.716	0.242	2.951	0.053
2-Enjoying Scenery	0.134	139.296	2	587	0.067	0.237	0.283	0.753
2-Chatting or walking	1.75	139.023	2	587	0.875	0.237	3.694	0.025*
2-Exercise facilities	0.115	66.095	2	587	0.058	0.113	0.511	0.6
2-Living facilities	0.387	59.005	2	587	0.193	0.101	1.924	0.147
2-Others	0.205	43.051	2	587	0.102	0.073	1.395	0.249
3-Reading or resting	0.173	147.244	2	587	0.086	0.251	0.345	0.709
3-Enjoying Scenery	0.206	145.334	2	587	0.103	0.248	0.416	0.66
3-Chatting or walking	0.242	143.977	2	587	0.121	0.245	0.493	0.611
3-Exercise facilities	0.114	60.817	2	587	0.057	0.104	0.548	0.578
3-Living facilities	0.111	43.984	2	587	0.055	0.075	0.741	0.477
3-Others	0.093	54.601	2	587	0.046	0.093	0.497	0.608
4-Reading or resting	0.265	136.387	2	587	0.133	0.232	0.57	0.566
4-Enjoying Scenery	0.131	139.064	2	587	0.065	0.237	0.275	0.759
4-Chatting or walking	0.18	136.473	2	587	0.09	0.232	0.387	0.679
4-Exercise facilities	0.14	69.013	2	587	0.07	0.118	0.595	0.552
4-Living facilities	0.136	63.077	2	587	0.068	0.107	0.635	0.53
4-Others	0.046	49.011	2	587	0.023	0.083	0.276	0.759
5-Reading or resting	0.557	128.611	2	587	0.278	0.219	1.27	0.282
5-Enjoying Scenery	1.198	134.905	2	587	0.599	0.23	2.606	0.075
5-Chatting or walking	0.184	138.035	2	587	0.092	0.235	0.39	0.677
5-Exercise facilities	0.031	74.844	2	587	0.015	0.128	0.121	0.886
5-Living facilities	0.002	39.008	2	587	0.001	0.066	0.016	0.984
5-Others	0.069	28.406	2	587	0.034	0.048	0.71	0.492
6-Reading or resting	0.194	115.494	2	587	0.097	0.197	0.492	0.612
6-Enjoying Scenery	0.11	120.052	2	587	0.055	0.205	0.27	0.764
6-Chatting or walking	0.236	144.817	2	587	0.118	0.247	0.477	0.621
6-Exercise facilities	0.134	80.919	2	587	0.067	0.138	0.485	0.616
6-Living facilities	0.148	125.709	2	587	0.074	0.214	0.346	0.708
6-Others	0.094	62.964	2	587	0.047	0.107	0.436	0.647

* $p<0.05$ ** $p<0.01$

For 1-living facilities, the level of 0.05 was significant ($f = 4.181$, $p = 0.016$), and the specific comparison showed that the average score of the groups with obvious differences was “1.0(male)>

2.0(female)". For 2-chatting or walking, the level of 0.05 is significant (f = 3.694, p = 0.025), and the specific comparison difference shows that the average score comparison result of the groups with more obvious differences is "2.0(female)> 1.0(male)".

4.3.3. Usage periods of the public green spaces

In this part, respondents could also choose multiple answers, who nearly didn't visit the campus green spaces (n=109) were ignored to this question (The total responds number is 481, answered by who "sometimes" and "often" moving around on campus" (as shown in Table 2), excluding "nearly no"). As shown in Figure 4.39, the results were a bit surprising, with the majority of respondents visiting the green space after class. On average, 137 people (n=481), accounting for nearly 28.5%, chose this period to move around on campus, of which space-4 was the most selected and 171 students would visit. The following, that the second choice was afternoon and the third choice before class, were very close to each other: an average of 54 students chose the afternoon period, and the largest number was in space-3; an average of 53 students chose the before class period, and the largest number was in space-4. One of the reasons was that space-4 was in the middle of the experimental building, teaching building and dormitory, which would be passed by students when they had classes from their dormitories. If the left time from class beginning was enough, a rest could be taken in space-4. And in the fourth frequently visited period, evening, averagely 46 respondents chose, and the most was also in space-3, a place with a pond, benches, pavilions and a gallery. As for the morning, there were very few people to choose, only 28, less than 5%. It can be seen that the utilization rate of green space was not high, students were still concentrated in the afternoon, after and before class, these three time periods to move around on campus.

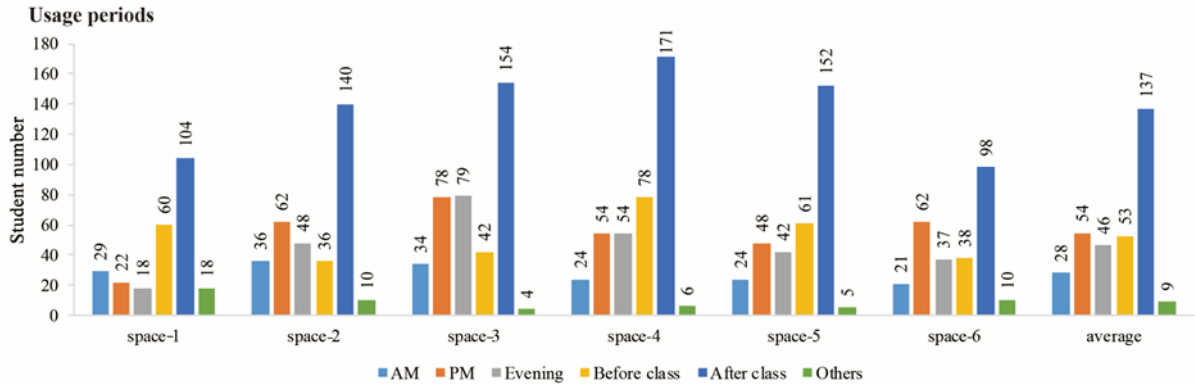

Figure 4.39 The frequently usage periods of the six public spaces (from space-1 to 6, n=481).

4.3.3.1. The influence of gender to the usage periods of public green spaces

Figure 4.40 clearly shows a peak, that 64.19% of male barely visit campus green space, a total of 95 persons (148 males participated in the survey). In comparison, the number of females who never visit public green spaces was very small, only 14 ones, accounting for 3.17%. An in-depth understanding of those who visited green spaces occasionally or frequently, found that male's most often visited periods was after class, with an average of 16.35% (n=53), followed by the second often visited period

of evening, with an average of 11.64%.

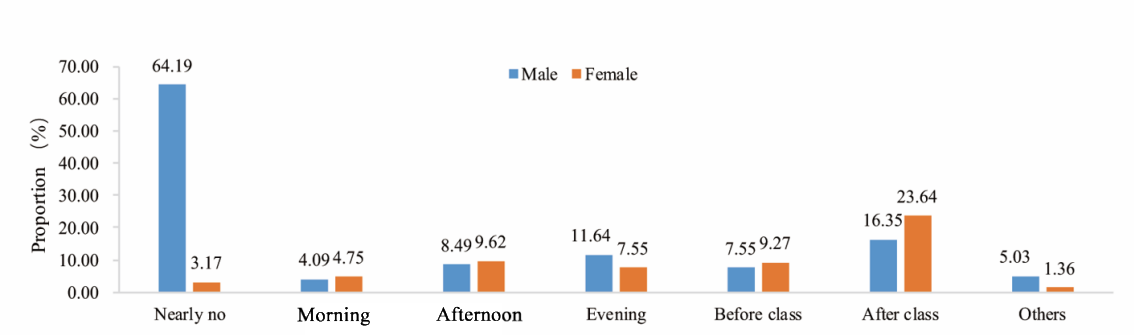

Figure 4.40 The impact of gender on the usage periods of visiting public green spaces on campus (The choosing of usage time excludes the persons nearly having no visiting).

In the morning, the number of visiting males was the smallest, which may be related to the habit of young people not wanting to get up early. After analyzing females' time, we also found that the largest number of persons would visit public green spaces after class, accounting for 23.64% (n=428), but the second most often period they liked was different from that of men. They chose afternoon. In combination with gender perception of security (Figure 4.14), female may feel that night is not safe enough, so choosing afternoon. We think that gender may lead to this difference.

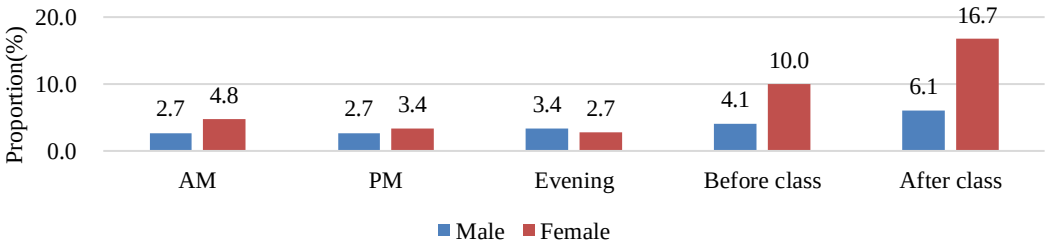

Figure 4.41 The proportion of various demands by different gender to public green space-1.

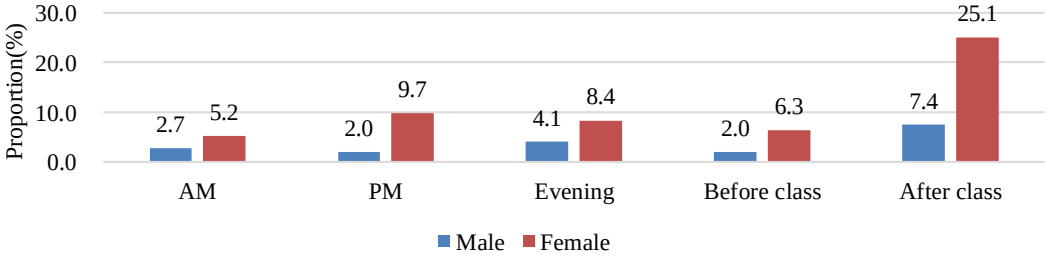

Figure 4.42 The proportion of various demands by different gender to public green space-2

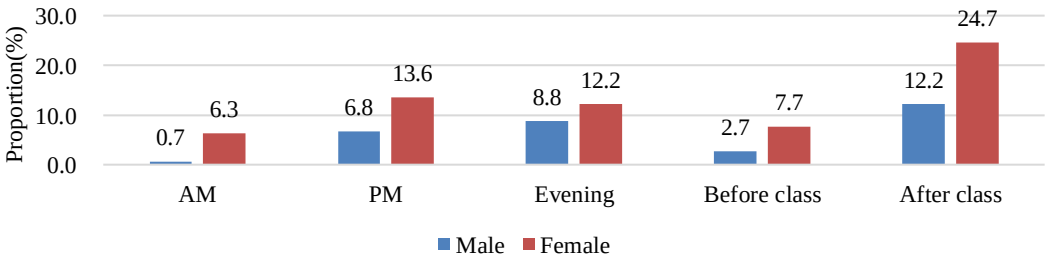

Figure 4.43 The proportion of various demands by different gender to public green space-3.

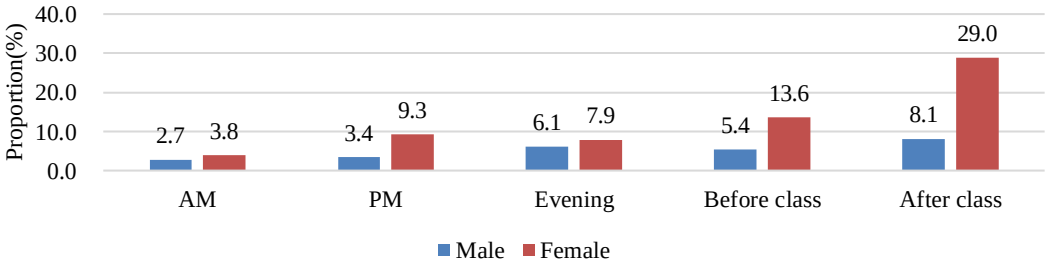

Figure 4.44 The proportion of various demands by different gender to public green space-4.

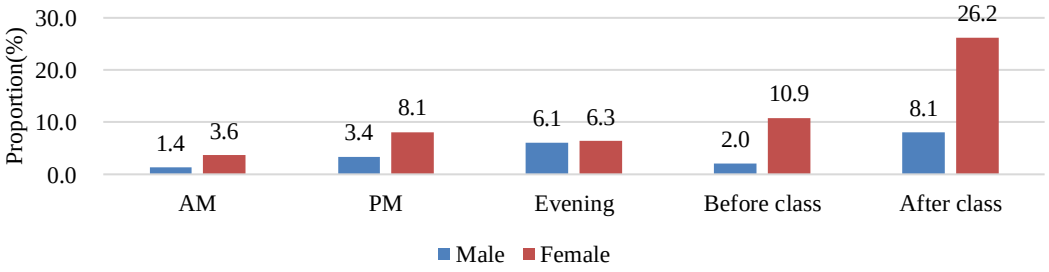

Figure 4.45 The proportion of various demands by different gender to public green space-5.

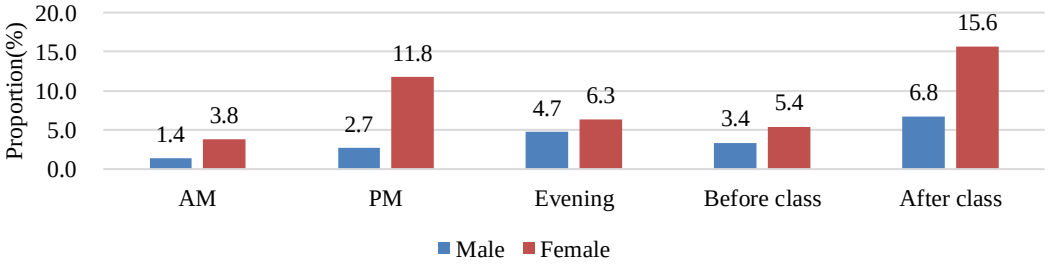

Figure 4.46 The proportion of various demands by different gender to public green space-6.

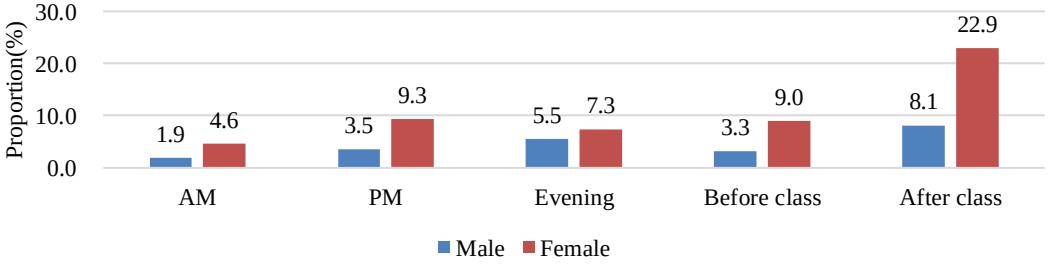

Figure 4.47 The average proportion of various demands by different gender to six public green spaces (from space-1-6).

Use the analysis of variance (one-way analysis of variance) to study the differences of the usage periods of 6 public green spaces. As can be seen from Table 4.8, different gender samples for space-1-morning, 1-afternoon, 1-before, 1-after, 2-morning, 2-afternoon, 2-eve, 2-before, 2-after, and so on, a total of 31 items showed no significant differences. But for gender samples for space-1-eve, 1-other, 3-eve, 4-eve, 5-eve, showed significant differences.

Table 4.8 ANOVA of the influence of gender to the usage periods of 6 public green spaces.

ANOVA of gender								
Usage period	SSB	SSW	df 1	df 2	MSB	MSW	F	p
1-Morning	0.033	23.668	1	479	0.033	0.049	0.666	0.415
1-Afternoon	0.077	18.172	1	479	0.077	0.038	2.031	0.155
1-Eve	0.207	16.192	1	479	0.207	0.034	6.133	0.014*
1-Before	0.005	44.797	1	479	0.005	0.094	0.055	0.815
1-After	0	68.677	1	479	0	0.143	0.003	0.955
1-Other	0.117	14.415	1	479	0.117	0.03	3.882	0.049*
2-Morning	0.022	25.462	1	479	0.022	0.053	0.419	0.518
2-Afternoon	0.091	41.51	1	479	0.091	0.087	1.047	0.307
2-Eve	0.034	39.122	1	479	0.034	0.082	0.413	0.521
2-Before	0.004	28.998	1	479	0.004	0.061	0.061	0.806
2-After	0.127	90.93	1	479	0.127	0.19	0.667	0.415
2-Other	0.016	7.85	1	479	0.016	0.016	1.005	0.317
3-Morning	0.102	27.149	1	479	0.102	0.057	1.803	0.18
3-Afternoon	0.111	59.702	1	479	0.111	0.125	0.89	0.346
3-Eve	0.669	56.998	1	479	0.669	0.119	5.623	0.018*
3-Before	0.001	34.997	1	479	0.001	0.073	0.01	0.92
3-After	0.34	93.127	1	479	0.34	0.194	1.75	0.186
3-Other	0.002	2.979	1	479	0.002	0.006	0.373	0.542
4-Morning	0.06	20.023	1	479	0.06	0.042	1.442	0.23
4-Afternoon	0	41.601	1	479	0	0.087	0.001	0.973
4-Eve	0.366	39.61	1	479	0.366	0.083	4.42	0.036*
4-Before	0.005	58.381	1	479	0.005	0.122	0.045	0.833
4-After	0.249	99.003	1	479	0.249	0.207	1.204	0.273
4-Other	0.002	2.979	1	479	0.002	0.006	0.373	0.542
5-Morning	0	17.326	1	479	0	0.036	0	0.99
5-Afternoon	0.005	37.5	1	479	0.005	0.078	0.063	0.802
5-Eve	0.514	33.64	1	479	0.514	0.07	7.318	0.007**
5-Before	0.146	45.447	1	479	0.146	0.095	1.534	0.216
5-After	0.094	93.844	1	479	0.094	0.196	0.479	0.489
5-Other	0.002	2.979	1	479	0.002	0.006	0.373	0.542
6-Morning	0	18.249	1	479	0	0.038	0.005	0.944
6-Afternoon	0.1	49.38	1	479	0.1	0.103	0.969	0.325
6-Eve	0.21	32.244	1	479	0.21	0.067	3.113	0.078
6-Before	0.069	27.183	1	479	0.069	0.057	1.217	0.271
6-After	0.036	65.989	1	479	0.036	0.138	0.258	0.612
6-Other	0	7.867	1	480	0	0.016	0.019	0.891

* p<0.05 ** p<0.01

Gender showed a significant level of 0.05 for 1-eve (f = 6.133, p = 0.014), and the specific contrast showed that the average value of 1.0 (male), 0.09 was significantly higher than the average value of 2.0 (female), 0.03.

Gender showed a significant level of 0.05 for 1-other (f = 3.882, p = 0.049), and the specific comparison showed that the average value of 1.0 (male), 0.08 was significantly higher than the average

value of 2.0 (female), 0.03.

Gender showed a significant level of 0.05 for 3-eve (f = 5.623, p = 0.018), and the specific comparison showed that the average value of 1.0 (male), 0.25 was significantly higher than the average value of 2.0 (female), 0.13.

Gender showed a significant level of 0.05 for 4-eve (f = 4.420, p = 0.036), and the specific contrast showed that the average value of 1.0 (male), 0.17 was significantly higher than the average value of 2.0 (female), 0.08.

Gender showed a significant level of 0.01 for 5-eve (f = 7.318, p = 0.007), and the specific comparison showed that the average value of 1.0 (male), 0.17 was significantly higher than the average value of 2.0 (female), 0.07.

Obviously, men in the four green spaces of space-1, 3, 4, and 5 were far more likely to visit in the evening than women, which may come from the higher safety of green space for men.

4.3.3.2. The influence of frequency of moving around on campus to the usage periods of public green spaces

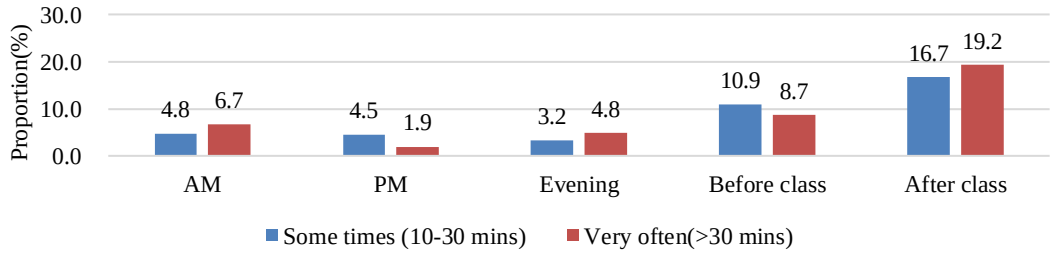

Figure 4.48 The proportion of various demands by different frequency of moving around on campus to public green space-1.

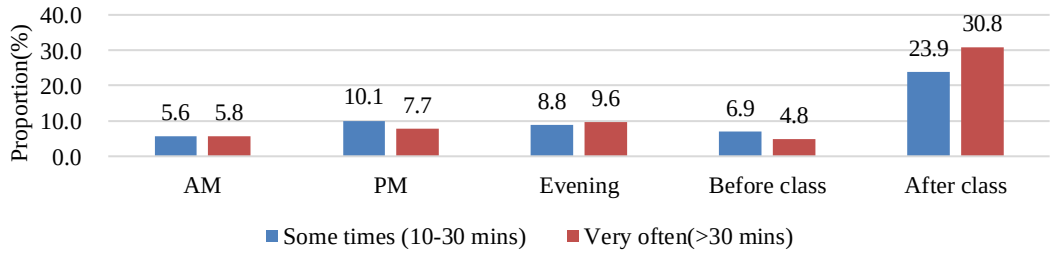

Figure 4.49 The proportion of various demands by different frequency of moving around on campus to public green space-2.

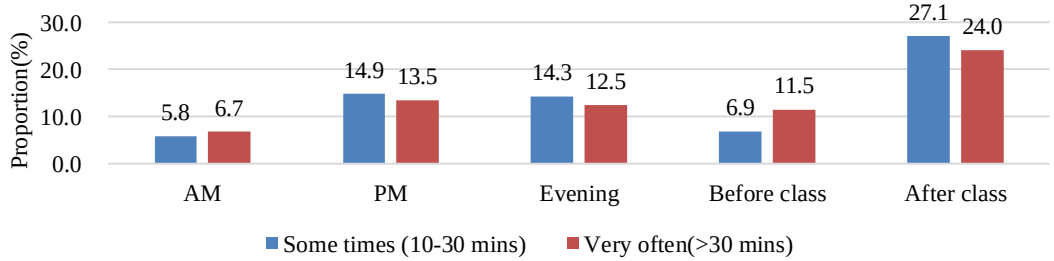

Figure 4.50 The proportion of various demands by different frequency of moving around on campus to public green space-3.

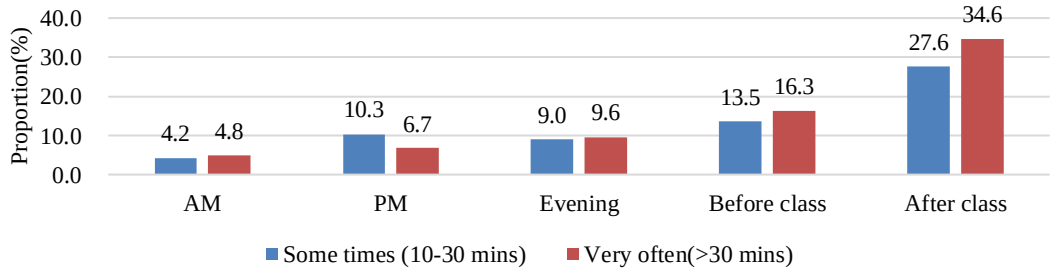

Figure 4.51 The proportion of various demands by different frequency of moving around on campus to public green space-4.

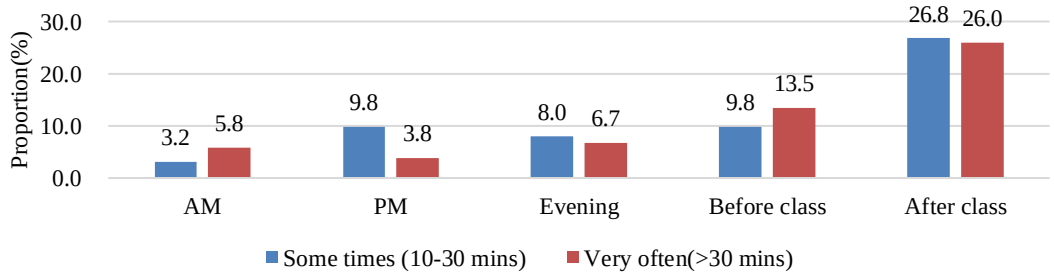

Figure 4.52 The proportion of various demands by different frequency of moving around on campus to public green space-5.

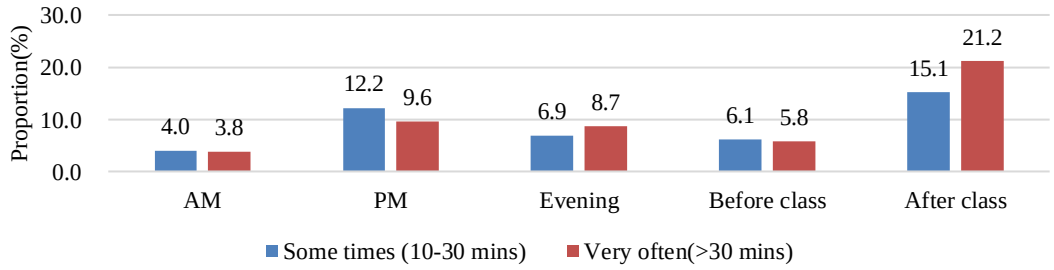

Figure 4.53 The proportion of various demands by different frequency of moving around on campus to public green space-6.

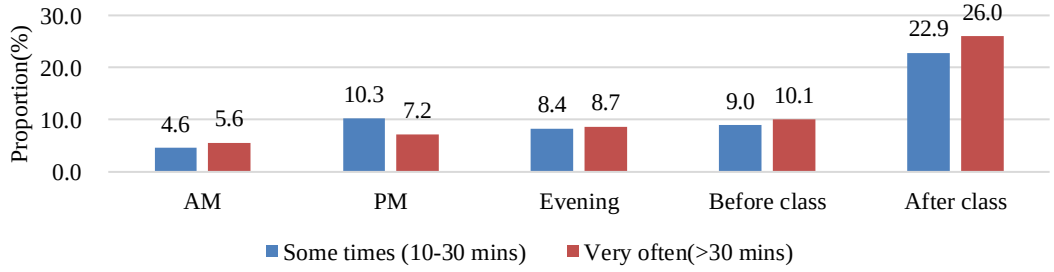

Figure 4.54 The average proportion of various demands by different frequency of moving around on campus to public green spaces (from 1-6).

Use the analysis of variance (one-way analysis of variance) to study the differences influence of frequency of visiting the campus to the usage periods. Respondents with different frequency of visiting the campus samples showed no obvious significance ($p > 0.05$).

Chapter 5.
Analysis of the accessibility about public green spaces based on Space syntax

5.1. Introduction of public green space's accessibility

Accessibility refers to the ease of access to services, activities, and destinations, known as the "potential of opportunities". An accessible transportation system can be defined as one that enables individuals to reach their destinations. An accessibility-based analysis can lead to better solutions to connection problems by providing benefits and congestion reduction in cost- effective ways. Access to public spaces has become a major issue in many cities in recent years. Accessibility concerns both non-disabled and disabled people, so all users benefit when the main routes are made accessible, as well as the need to make access attractive.

This chapter aimed to evaluate and improve the accessibility of the six public green spaces and to interpret the connection behavior of public green spaces according to the road systems in a campus scale and the design space in the campus planning aspect. The findings will contribute a better understanding of the accessibility of public green spaces and their relationship with their surrounding environments; the results can also be useful for designing green spaces or ongoing green spaces projects on other campuses.

5.2. Integration of public green spaces

5.2.1. Axial line analysis

According to the spatial perception, divide the large-scale space into a series of small-scale space. The relevant index of each axis represents the convenience of movement, transfer, forward and other capabilities. And travel along the axial direction is the most economical and convenient movement6). As shown in Figure 5.1, the black lines are axial lines analyzed by Space syntax theory.

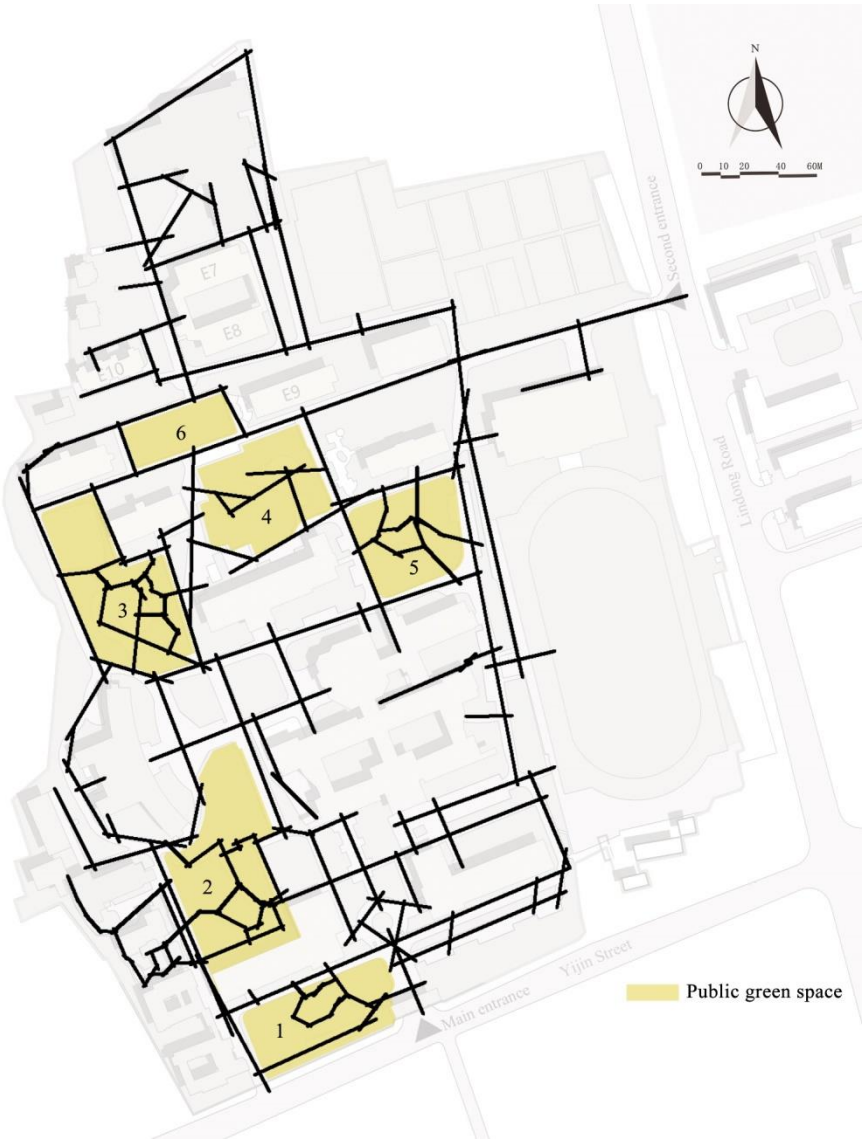

Figure 5.1 Axial line analysis of Yijin Campus based on Space syntax.

5.2.2. Integration value analysis

The specificity data of the connectivity transfer the road space into axial lines and were used to calculate the integration value. The results analysis uses integration value (Int.V), global integration value (Global Int.V), representing the tightness of the contact between one node and all the nodes throughout the system, and local integration value (Local Int.V), usually taking the activity goal center and has three topology steps, and representing tightness between one node and its surrounding nodes in the system. It disperses the degree to which one-unit space connects with all other parts in the same system. A high integration value means a space with high accessibility.

Minimum Global Int.V is the minimum integration value of accessibility. A place with the Minimum Global Int.V is remote and hard to get to. Maximum Global Int.V is the maximum integration value of accessibility. A place with the Maximum Global Int.V is very convenient to get to and has a high

degree of utilization. Average Int.V is the mean integration value of accessibility, which describes an average degree of accessibility.

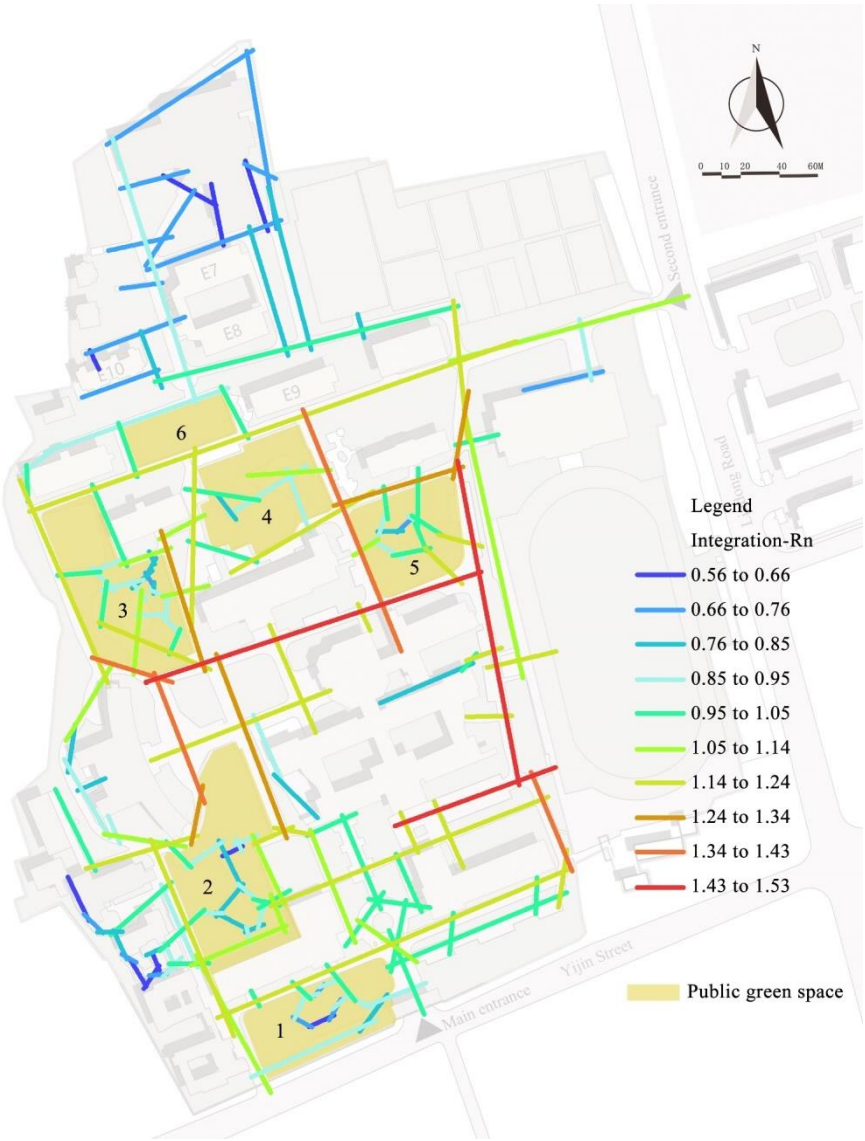

Figure 5.2 The global integration (Rn) of spatial structure of Yijin Campus.

Figure 5.2 (Source: own illustration, based on data from Zhejiang A&F University, 2018) shows the integration distribution of the campus in relation to the axial maps for each level of road networks. As expected, some roads were more integrated into network than others, which were most significant at the Rn or global level. As indicated in Figure 5.2, around space-5 several main roads were strongly integrated at the global level (red and orange lines), which means a certainly center of public green space on overall campus, which should be accessible from a wide section of the campus as a whole. Specific Rn integration values can be referred to Table 3 that, space-5 has the highest average Rn integration of 1.43. If just according to the value, people will more possible to visit space-5. Conversely, the least integrated areas (turquoise and blue) lie in the periphery and particularly in the north, around

the canteen, suggesting that it was not so easily accessible. As shown in Figure 5.1, the Global Int.V of space-6 was low, with 1.03 averagely, even the maximum road entrance was only of 1.22. Likewise, in the south, around space-1 and parts of the west of the campus, behind of the library, the Global Int.V was also low. Especially, space-1, which owns a lowest average Global Int.V compared to the other public green spaces.

Looking at local integration (R3), we can see that the pattern was very similar: the highly integrated areas appeared tightly connected with the campus, and often exchanged with locally non-integrated areas. Thus, some spaces emerged as being locally accessible which were also at the global level. However, the Local Int.V of space-2 was not so highly (ranked 4), but with a relatively high Global Int.V (ranked 3), which meat its connection with surroundings was not so close. Apart from this, the Local Int.V of the other five green spaces were roughly the same rank as the Global Int.V.

Table 5.1. The integration of spatial structure of six green spaces analyzed by Space syntax

Green space	1	2	3	4	5	6
Global Int.V (Rn)						
Maximum	1.29	1.38	1.53	1.35	1.53	1.22
Minimum	0.80	1.06	1.01	1.01	1.30	0.88
Average	1.01	1.20	1.24	1.18	1.43	1.03
Local Int.V (R3)						
Maximum	2.70	2.65	2.73	2.52	2.73	2.52
Minimum	1.33	1.58	1.73	1.60	2.21	1.73
Average	1.91	2.00	2.19	2.14	2.47	1.95

5.3. Impact of integration of public green spaces

5.3.1. Impact of integration on convenience of public green spaces

According to the collected questionnaires, we analyzed the problem that "How convenient it is from the main campus gate, from your dormitory or from anywhere of the campus to each of these public spaces?", and the results were shown in Figure 5.3. Throughout the green spaces, students generally felt that it was relatively convenient to go from the main entrance to anyone of them. Space-1 had the highest score of 4.76, obviously because of its position of nearest from the main entrance. Then space-2, a satisfaction of 4.40, was the secondly convenient public green space from the main entrance, which can be seen from the whole campus map. Space-6 was the farthest from the main entrance, thus it had the least convenience satisfaction of 2.67. Conversely, from the dormitory, the students found space-6 to be the most convenient, scoring 2.95, because it was closest to their dormitories. Furthermore, from anywhere of the campus to the green spaces, respondents considered that space-5 was the most convenient, with a satisfaction of 3.84, and space-1 was the most inconvenient, with a score of 3.46, which was consistent with the accessibility of Space syntax theory. As indicated in Figure 5.4, the trend of Global Int.V was mostly similar with that of satisfaction of convenience from

anywhere on campus, except the public green space-4, with a high Global Int.V of 3.75, but a relatively low convenience value of 1.18, whose ranking was respectively third and fourth position. Space-5 had the highest Global Int.V of 3.84 and highest convenience value from anywhere of 1.43. Correspondingly, space-1 had the lowest, scoring 3.46 and 1.01. Actually, the convenience from anywhere on campus means the whole campus accessibility. The higher convenience the whole campus has, the better accessibility the public green space has. Therefore, as the convenience of the campus space considered by the respondents was roughly the similar as the sorting of integration analyzed by Space syntax theory, the Space syntax theory of Hillier,(1997) works to a degree and in this case is similarly as revealing as we hoped it might be, especially in the ideal state not affected by such as traffic, road quality and so on (Hillier 1997).

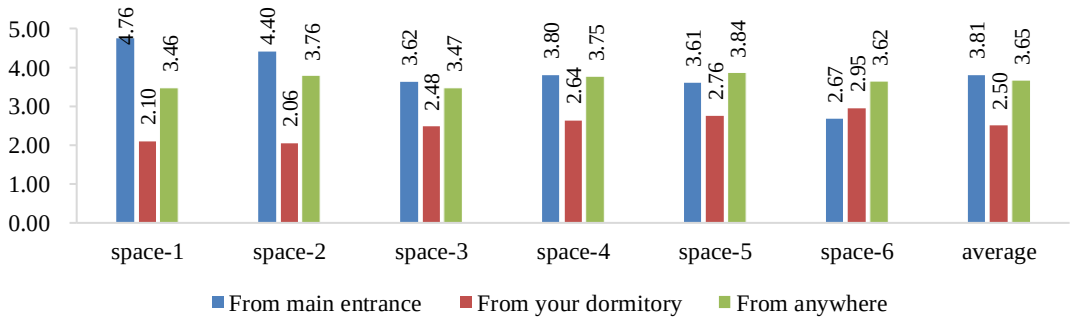

Figure 5.3 The perception of convenience to the six public spaces (from space-1 to 6).

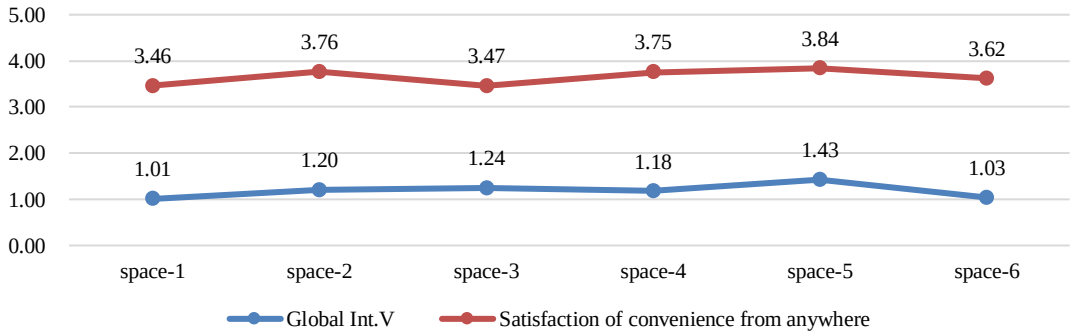

Figure 5.4 The relationship of Global Int.V of six public spaces (from space-1 to 6) and students' perception of convenience from anywhere on campus.

5.3.2. Impact of integration on safety of public green spaces

This study has come to a conclusion that the convenience is positively related to accessibility of the campus: the higher the convenience, the better the connectivity of the space, and the higher the accessibility. According to the survey, accessibility and safety are also positively correlated. As shown in Figure 5.5, their trends are basically the same. The three green spaces with the highest global

integration: spaces-2, 3 and 5, were also the three ones that respondents felt the most secure. Similarly, the global integration of space-1 was 1.01, which was the lowest of the six green spaces, and the respondent's safety rating was also the lowest, only 3.8 points. According to the survey, the worse the accessibility and the remoteness is, the less the safety of students feel. Therefore, schools should strengthen the construction of sites of low accessibility, such as setting up light sources and providing more patrol inspections. This finding at least seems to be some-what consistent with space syntax theory (Hillier 1997), which works to a degree.

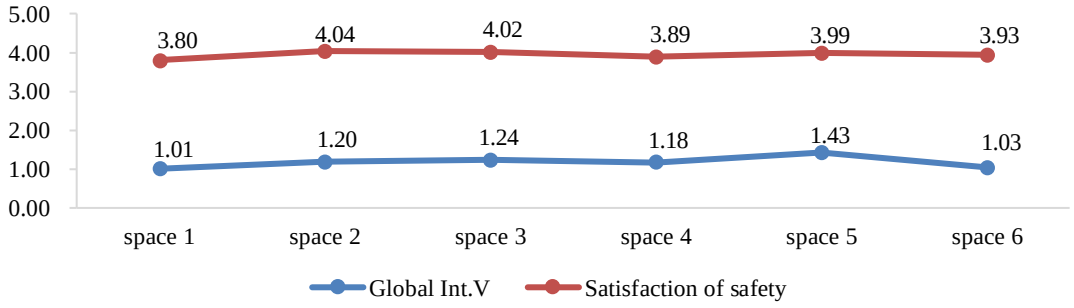

Figure 5.5 The relationship of Global Int.V of six public spaces (from space-1 to 6) and students' perception of safety of green spaces on campus.

Chapter 6.
Analysis on the perception of respondents about main building spaces based on post-occupancy evaluation

6.1. Basic information of main building spaces

Figure 6.1The overall layout and the main building spaces of YWICC.

According to the "General Colleges and Universities Building Area Index", the main buildings that ordinary colleges and universities must deploy are: classrooms, experimental and practical training rooms and places, libraries, indoor sports houses, school administrative and office buildings,

departments and teachers. Office room, teacher and student activity room, hall, student dormitory (apartment), cafeteria, single teacher dormitory (apartment), logistics and auxiliary room, a total of 12 items.

In many colleges and universities, training buildings, libraries, college teaching buildings, office buildings, public teaching buildings, activity centers, small lecture halls (Ladder promenade in this thesis), large halls (Report hall in this thesis), student dormitories (Lvzhuyuan apartment, Danguiyuan apartment and Hupan apartment in this research), and dining hall (Lvzhuyuan dining hall and Danguiyuan dining hall in this research) are common functions. Therefore, as shown in Figure 6.1(Own illustration, based on data from YWICC, 2018), in this case, the above 14 major architectural building spaces were selected, and the campus planning was reconsidered according to students' post-occupancy evaluation.

(1) Practical building and its entraces in YWICC

(2) Library and its entrances in YWICC

(3) Xuefeng building and its entrances in YWICC

(4) Gym and its entrances in YWICC

They are Practical building (6 floors and the floor area of 19900 ㎡), Library (5 floors and the floor area of 11200 ㎡), Xuefeng building (4 floors and the floor area of 12128 ㎡), Gym (1 floor and the floor area of 20000 ㎡), Wangdao building (5 floors and the floor area of 19700 ㎡), Chunhan building (5 floors and the floor area of 19800 ㎡), Activity center (2 floors and the floor area of 10280 ㎡), Ladder

(5) Chunhan building and its entrances in YWICC

(6) Wangdao building and its entrances in YWICC

(7) Activity center and its entrances in YWICC

(9) Lvzhuyuan apartment and its entrances in YWICC

(8) Ladder promenade and its entrances in YWICC

promenade (1 floors and the floor area of 1540 ㎡), Lvzhuyuan apartment (from apartment-1 to 5, 6 floors and the floor area of 27200 ㎡), Lvzhuyuan dining hall (3 floors and the floor area of 12060 ㎡), Hupan apartment (5 floors and the floor area of 7600 ㎡), Danguiyuan apartment (from apartment-1 to 7, 4 floors and the floor area of 40740 ㎡), Danguiyuan dining hall (1 floor and the floor area of 5120 ㎡), Report hall (5 floors and the floor area of 8149 ㎡), with a floor area ratio of 0.60. In addition, the floor elevation of Activity center, Danguiyuan apartment and Danguiyuan dining hall are relatively higher than the other 11 buildings, which are flat and relatively compact.

The training building is a place for students' experimental practice, where some training courses are arranged, and students must come for classes and studies. As shown in Figure 6.1, it is northeast of the school and north of the library. The library is located at the main entrance of the school and can be seen when entering the

(10) Lvzhuyuan dining hall and its entrances in YWICC

(11) Hupan apartment and its entrances in YWICC

(12) Danguiyuan apartment and its entrances in YWICC

(13) Danguiyuan dining hall and its entrances in YWICC

(14) Danguiyuan apartment and its entrances in YWICC

campus, which is the main place for students to study in addition to classes in the teaching building, with a high importance. Xuefeng building is located on the left side of the school main entrance. It is a department building, which is mainly used by the faculty of e-commerce. The gym is located to the east of the campus, which is the main place for students to exercise indoor sports, where basketball and badminton venues can be supported. Chunhan building is the school's main public teaching building, where most of the students' courses are conducted. At the same time, it is also located on the main road of the school, Hangda Road, which is very convenient for students to take classes. Wangdao building is closely connected to Chunhan building, at the north of it, which is the school's office building, mainly used for teachers and student affairs. Lvzhuyuan apartments, Lvzhuyuan dining hall and Hupan apartment are also located on both sides of the campus's main road, Hangda Road, followed by Ladder promenade and Activity center.

Table 6.1 Basic information of 14 main buildings

Buildings/ topics	Floor	Number	Building function
Practical building	19900	6	Experimental building
Library	11200	5	Library and Leisure
Xuefeng building	12128	4	Teaching building for Faculty of E-commerce
Gym	20000	1	For playing basketball and inner sports
Wangdao building	19700	5	Office building
Chunhan building	19800	5	Teaching building for all students
Activity center	10280	2	Student clubs and cultural events
Ladder promenade	1540	1	Larger classroom
Lvzhuyuan apartment	27200	6	Student dormitory, from apartment-1 to 5
Lvzhuyuan dining hall	12060	3	Specialty food (1st floor), Fast food (2nd floor),
Hupan apartment	7600	5	Student dormitory
Danguiyuan apartment	40740	4	Student dormitory, from apartment-1 to 7
Danguiyuan dining hall	5120	1	Specialty food and fast food
Report hall	8149	5	Teaching building for Faculty of Creatives Studies

6.2. Basic information of respondents

As shown in Table 6.2, a total of 1412 pieces of questionnaires online was collected through the website of wenjuan.com. Males accounted for a minority, only 39.52%, far less than females (60.48%). As far as the student grade was concerned, the proportions were also relatively greatly different. The Grade 1 and Grade 2 students accounted for more than 85% of the total number of respondents, 59.07% and 26.77% respectively. The proportion of Grade 3 ratio (14.16%) was far less than Grade 1 and Grade 2, which may be caused that many of the Grade 3 students have practiced off-campus, so they did not fill out the questionnaire. Besides, there are 7 faculties, Faculty of Humanities and Tourism, Faculty of Mechanics and IT, Faculty of Economics and Management, Faculty of Foreign Studies, Faculty of Architectural Engineering, Faculty of Creatives Studies and Faculty of E-commerce of Economics. Regarding the dormitory of respondents, the proportion of growing up in Danguiyuan apartment was the largest, reaching 54.25%, followed by students in Lvzhuyuan apartment, accounting for nearly 40%. Most, 76.35% of the respondents had part-time job and most of them were off-campus, but 16.14% of them both had part-time job on and off-campus. In addition, the question “how much time students spend on campus averagely every day” was shown in Table 6.1. Obviously, 48.8% of the students choose to stay on campus always (80% -100% of the day), and 38.24% of the students stay usually (60% -80%). In total, more than 87% of the students are on campus, which show an impact of Chinese universities on students, who live on campus, study, and even work part-time.

Table 6.2 Basic information of respondents

Item	Group	Number	Proportion (%)
Gender	Male	558	39.52
	Female	854	60.48
Grade	Grade 1	834	59.07
	Grade 2	378	26.77
	Grade 3	200	14.16
Faculty	Faculty of Humanities and Tourism	218	15.44
	Faculty of Mechanics and IT	207	14.66
	Faculty of Economics and Management	143	10.13
	Faculty of Foreign Studies	392	27.76
	Faculty of Architectural Engineering	135	9.56
	Faculty of Creatives Studies	149	10.55
	Faculty of E-commerce	168	11.90
Dormitory	Danguiyuan apartment	766	54.25
	Lvzhuyuan apartment	565	40.01
	Hupan apartment	56	3.97
	Off-campus housing	22	1.56
	Others	3	0.21
Part-time job	Yes	1078	76.35
	No	334	23.65
Place of part-time job	On-campus	28	2.60
	Off-campus	876	81.26
	Both	174	16.14
Percentage of staying on campus	Seldom (0-20%)	22	1.56
	Sometimes (20%-40%)	27	1.91
	Often (40%-60%)	134	9.49
	Usually (60%-80%)	540	38.24
	Always (80%-100%)	689	48.80
Main activities on campus (6 choices at most)	Sleeping	997	70.61
	Having classes and studying	1245	88.17
	Playing games	653	46.25
	Dining	798	56.52
	Chatting and collective activities	795	56.30
	Surfing the Internet	896	63.46
	Shopping online	469	33.22
	Part-time jobs online	103	7.29
	Sports and other outdoor activities	437	30.95
	Others	508	35.98

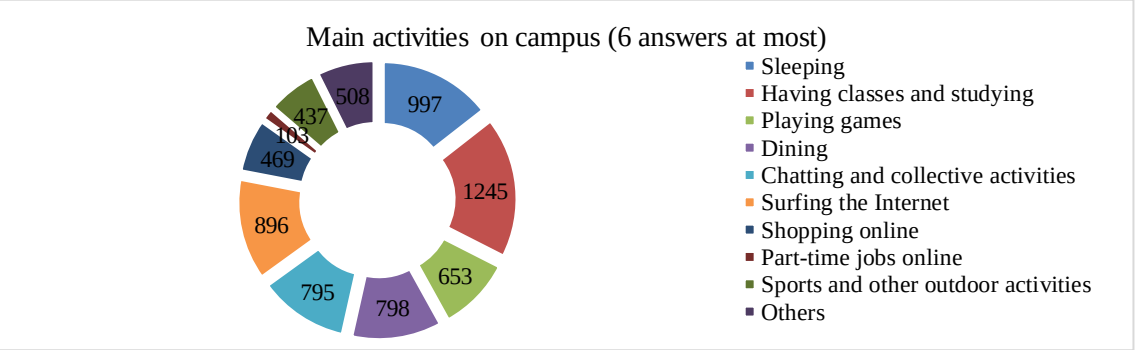

Figure 6.2 The respondents numbers with mdifferent activities on cmpus.

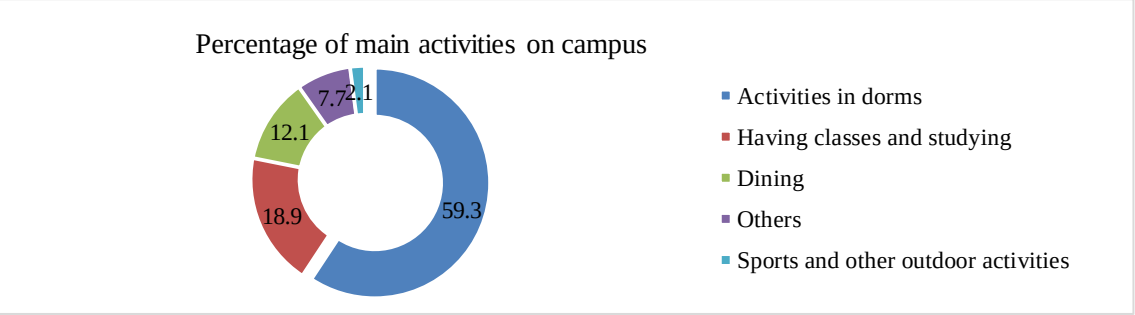

Figure 6.3 The percentage of respondents in YWICC with mdifferent activities on cmpus.

Respondents were able to choose at most six activities which were frequently performed on campus, as shown in Figure 6.2 and Figure 6.3. Among them, if sleeping, playing games, chatting and collective activities, surfing the Internet, shopping online and part-time jobs online are classified as activities in the dorms, it accounts for 59.3%, more than half, which can be seen in the current campus that so large the proportion and time of students staying in the dormitory is. Having classes and studying followed, accounting for 18.9%. Then followed by dining, accounting for 12.1%. The least selected were sports and other outdoor sports, with only 2.1% being selected. On the campus, the frequency of outdoor activities for students has been severely reduced, which indicates so serious an issue that deserves attention and concerns about students' physical and mental health and the sustainable development of the campus.

6.2.1. The influence of dormitory to students' main activities on campus

Use the analysis of variance (one-way analysis of variance) to study the influence of students' dormitory to their main activities on campus. As can be seen from Table 6.3, main activities-chatting and collective activities, surfing the internet, part-time jobs online, others ($p > 0.05$), a total of 4 items showed no significant differences. However, the dormitory sample showed significance for 6 items of main activities-sleeping, having classes and studying, playing games, dining, shopping online, sports and other outdoor activities ($p < 0.05$). Specific analysis shows (1.0 means Danguiyuan apartment; 2.0 means Lvzhuyuan apartment; 3.0 means Hupan apartment; 4.0 means off-campus; 5.0 means others): Different dormitory samples showed a 0.01 level of significance ($F = 4.817$, $p = 0.001$) for Main

activities-Sleeping, and the specific comparison showed that the average score comparison results of the groups with significant differences were "1.0> 2.0; 1.0> 4.0; 2.0> 4.0; 3.0> 4.0 "(also can be seen from Figure 6.4 for visual display). On average, 74% of students in Danguiyuan apartment chose sleep as their main activity, which was significantly more than the main activity of students in Lvzhuyuan apartment.

Table 6.3 ANOVA of the influence of respondents' dormitory to their main activities on campus.

ANOVA of dormitory								
Main activities	**SSB**	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
Sleeping	3.959	289.069	4	1407	0.99	0.205	4.817	0.001**
Having classes and studying	1.224	146.024	4	1407	0.306	0.104	2.949	0.019*
Playing games	9.005	342.005	4	1407	2.251	0.243	9.262	0.000**
Dining	4.371	342.635	4	1407	1.093	0.244	4.487	0.001**
Chatting and collective activities	0.435	346.955	4	1407	0.109	0.247	0.441	0.779
Surfing the Internet	1.325	326.109	4	1407	0.331	0.232	1.429	0.222
Shopping online	5.846	307.374	4	1407	1.462	0.218	6.691	0.000**
Part-time jobs online	0.31	95.177	4	1407	0.078	0.068	1.146	0.333
Sports and other outdoor activities	2.349	299.404	4	1407	0.587	0.213	2.76	0.027*
Others	1.004	324.231	4	1407	0.251	0.23	1.089	0.36
* p<0.05 ** p<0.01								

Table 6.3 is the ANOVA of the influence of respondents' dormitory to their main activities on campus. Different dormitory samples showed a significant level of 0.05 for main activities-having classes and studying (f = 2.949, p = 0.019), and the specific comparison showed that the average score comparison result of the groups with significant differences was "1.0> 5.0; 2.0 > 5.0; 3.0> 5.0; 4.0> 5.0 "(can also be visually displayed from Figure 6.4). On average, 90% of students in Danguiyuan apartment chose to attend classes, which is higher than the others.

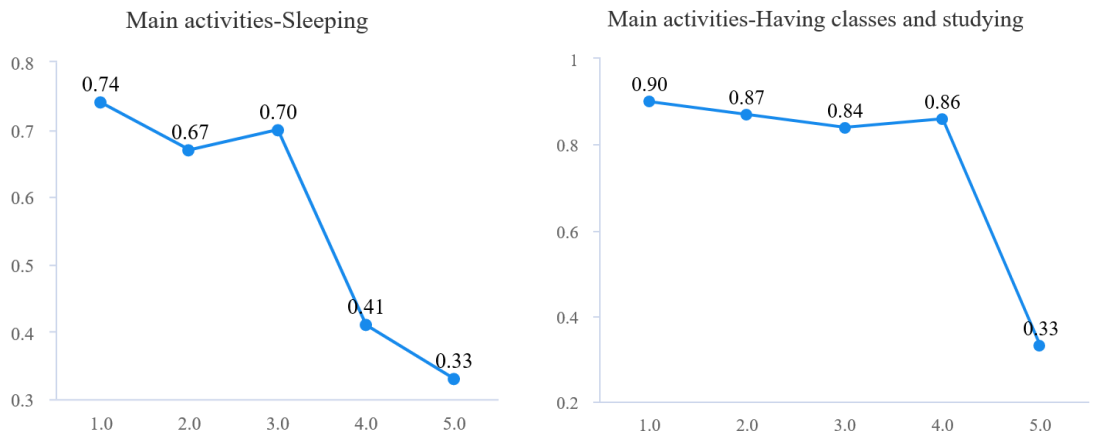

Figure 6.4 The proportion of students' main activities-sleeping and having classes and study on campus living in different dormitories.

Different dormitory samples showed a 0.01 level of significance (f = 9.262, p = 0.000) for main activities-playing games, and the specific comparison showed that the average score comparison results of the groups with significant differences were “2.0> 1.0; 3.0> 1.0 ; 3.0> 2.0; 2.0> 4.0; 3.0> 4.0; 3.0> 5.0 "(can also be visually displayed from Figure 6.5).

Different dormitory samples showed 0.01 level of significance (f = 4.487, p = 0.001) for main activities-dining, and the specific comparison showed that the average score comparison results of the groups with significant differences were "1.0> 2.0; 1.0> 4.0; 1.0> 5.0 "(can also be displayed visually from Figure 6.5).

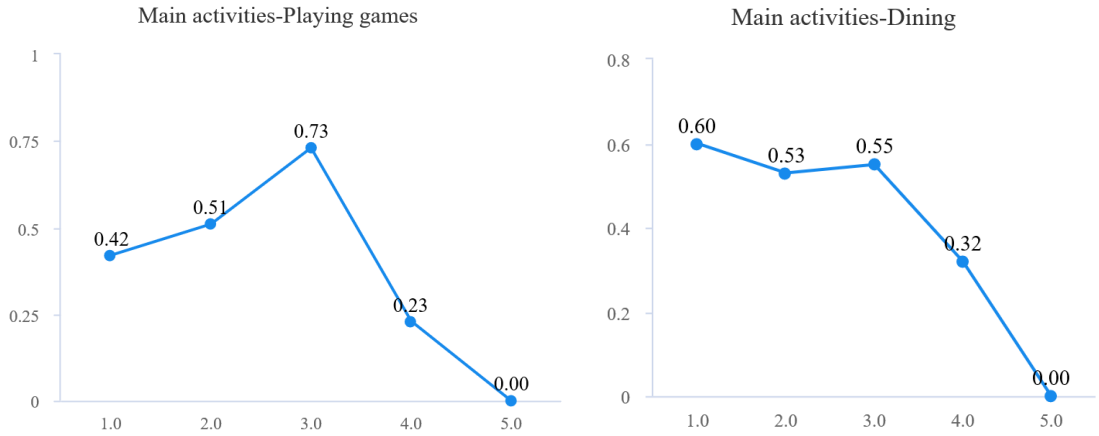

Figure 6.5 The proportion of students’ main activities-playing games and dining classes and study on campus living in different dormitories.

Different dormitory samples showed a 0.01 level of significance (f = 6.691, p = 0.000) for main activities-shopping online, and the specific comparison showed that the average score comparison results of the groups with significant differences were “1.0> 2.0; 1.0> 3.0 ; 2.0> 3.0 ”(also can be seen from Figure 6.6 for visual display). The average proportion of students who live in Danguiyuan apartments is 38%, which is much higher than 29% of Lvzhuyuan apartments and 13% of Hupan apartments.

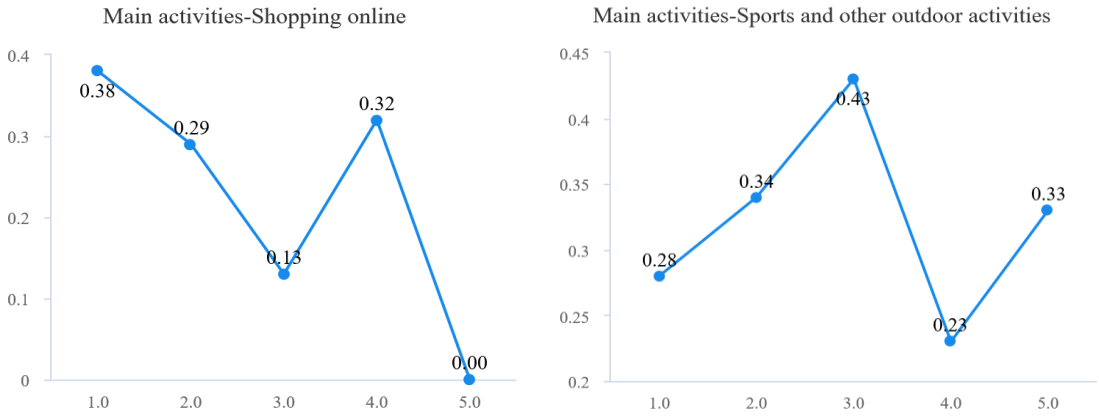

Figure 6.6 The proportion of students’ main activities-shopping online and sports and other outdoor activities on campus living in different dormitories.

Different dormitory samples showed a 0.05 level of significance (f = 2.760, p = 0.027) for main activities-sports and other outdoor activities, and the specific comparison showed that the average score comparison results of the groups with significant differences were "2.0> 1.0; 3.0> 1.0 "(can also be displayed visually from Figure 6.6). Obviously, only 28% of students in Danguiyuan chose to go out for sports or do some outdoor activities. However, the proportion of students in the Lvzhuyuan and Hupan apartment is far higher than the former when they go outside the bedroom to participate in outdoor lake activities.

In summary, different dormitory samples will not show significant differences for the four items, main activity-chatting and collective activities, surfing the internet, part-time jobs online, and others. However, there is an obvious difference about the main activity-sleeping, having classes and studying, playing games, dining, shopping online, sports and other outdoor activities. Among them, we can clearly see that the proportion of students living in Danguiyuan who choose to sleep, shop online and other activities that are mainly performed in the dormitory is significantly higher than the other places, although they have the most classes. At the same time, the proportion of students living here choosing outdoor activities is significantly lower than other apartments.

6.2.2. The influence of gender to students' main activities on campus

It can be seen from Table 6.4 above: different gender samples will not show significant results for the 2 main activities-chatting and collective activities, others (p>0.05), which means that different gender samples will have no different about main activities-chatting and collective activities, and others. However, gender samples for main activity-sleeping, having classes and studying, playing games, dining, surfing the internet, shopping online, part-time jobs online, activities-sports and other outdoor activities, a total of 8 items of main that are significant (p <0.05), which means that different gender samples are important. Specific analysis shows (1.0 means male and 2.0 means female):

Table 6.4 ANOVA of the influence of respondents' gender to their main activities on campus.

ANOVA of gender								
Main activities	**SSB**	**SSW**	**df 1**	**df 2**	**MSB**	**MSW**	**F**	**p**
Sleeping	4.741	288.28	1	141	4.741	0.204	23.18	0.000*
Having classes and studying	2.004	145.24	1	141	2.004	0.103	19.45	0.000*
Playing games	30.794	320.21	1	141	30.79	0.227	135.5	0.000*
Dining	6.929	340.07	1	141	6.929	0.241	28.72	0.000*
Chatting and collective	0.514	346.87	1	141	0.514	0.246	2.09	0.149
Surfing the Internet	3.442	323.99	1	141	3.442	0.23	14.98	0.000*
Shopping online	17.724	295.49	1	141	17.72	0.21	84.57	0.000*
Part-time jobs online	0.693	94.793	1	141	0.693	0.067	10.31	0.001*
Sports and other outdoor	6.914	294.83	1	141	6.914	0.209	33.06	0.000*
Others	0.282	324.95	1	141	0.282	0.23	1.223	0.269
* p<0.05 ** p<0.01								

Gender showed 0.01 level of significance (f = 23.186, p = 0.000) for main activity-sleeping, and the specific contrast difference shows that the average value of 1.0 (0.63) will be significantly lower than the average value of 2.0 (0.75).

Gender showed 0.01 level of significance (f = 19.451, p = 0.000) for main activity-having classes and studying, and the specific contrast difference shows that the average value of 1.0 (0.84) will be significantly lower than the average value of 2.0 (0.91).

Gender showed 0.01 level of significance (f = 135.596, p = 0.000) for main activity-playing games, and the specific contrast difference shows that the average value of 1.0 (0.65) is significantly higher than the average value of 2.0 (0.34).

Gender showed 0.01 level of significance (f = 28.728, p = 0.000) for main activity-dining, and the specific contrast difference shows that the average value of 1.0 (0.48) will be significantly lower than the average value of 2.0 (0.62).

Gender showed a 0.01 level of significance (f = 14.981, p = 0.000) for main activity-surfing the internet, and the specific comparison showed that the average value of 1.0 (0.57) will be significantly lower than the average value of 2.0 (0.67).

Gender showed 0.01 level of significance (f = 84.573, p = 0.000) for main activity-shopping online, and the specific contrast difference shows that the average value of 1.0 (0.19) will be significantly lower than the average value of 2.0 (0.42).

Gender showed 0.01 level of significance (f = 10.312, p = 0.001) for main activity-part-time jobs online, and the specific contrast difference shows that the average value of 1.0 (0.10) is significantly higher than the average value of 2.0 (0.06).

Gender showed 0.01 level of significance (f = 33.064, p = 0.000) for main activity-sports and other outdoor activity, and the specific contrast difference shows that the average value of 1.0 (0.40) is significantly higher than the average value of 2.0 (0.25).

The summary shows that different gender samples will not show significant differences for the two main activity-chatting and collective activity, main activity-others, and the gender samples for main activity-sleeping, main activity-having classes and studying, main activity- playing games, main activity-dining, main activity-surfing the internet, main activity-shopping online, main activity-part-time jobs online, main activity-sports and other outdoor activity showed significant differences. Women's main activity in school are far higher than men's choices in the five items of sleep, class, meals, internet, and online shopping, but they are significantly less than men's in terms of online part-time, sports and outdoor activity.

In summary, women's main activities on campus are far higher than men's choices in the five items of sleeping, having classes and study, dining, surfing on internet, and shopping online. But as for the part-time online, and sports and outdoor activities, it is obvious lower than men.

6.3. Evaluation of respondents about main building spaces

6.3.1. The space and indoor facilities condition on campus

6.3.1.1. Satisfaction of the space size of the 14 buildings

Table 6.5 Satisfaction of the space size of the 14 buildings.

	1 point	2 points	3 points	4 points	5 points	Average points
Practical building	53	62	307	381	609	4.01
Library	66	71	316	378	581	3.95
Xuefeng building	57	66	334	379	576	3.96
Gym	57	69	325	377	584	3.96
Wangdao building	44	54	301	389	624	4.06
Chunhan building	40	39	275	390	668	4.14
Activity center	59	98	358	358	539	3.86
Ladder promenade	48	54	297	392	621	4.05
Lvzhuyuan apartment	130	121	340	319	502	3.67
Lvzhuyuan dining hall	66	88	344	377	537	3.87
Hupan apartment	71	88	348	350	555	3.87
Danguiyuan apartment	67	56	294	379	616	4.01
Danguiyuan dining hall	58	77	322	364	591	3.96
Report hall	62	65	322	361	602	3.97

As shown in Table 6.5 (n=1412) and Figure 6.7 (n=1412), the students' satisfaction with Chunhan building was the highest, with a score of 4.14, which showed that the interviewees were very satisfied with it. This is a public teaching building where students take major courses and the utilization rate is very high. Followed by Wangdao building and Ladder promenade, students scored 4.06 and 4.05 respectively, which are office buildings and small lecture halls respectively, and their utilization rate was relatively low. The worst satisfaction was Lvzhuyuan apartment, 40.01% of the respondents living in this dormitory, which can be seen that the student satisfaction was very poor.

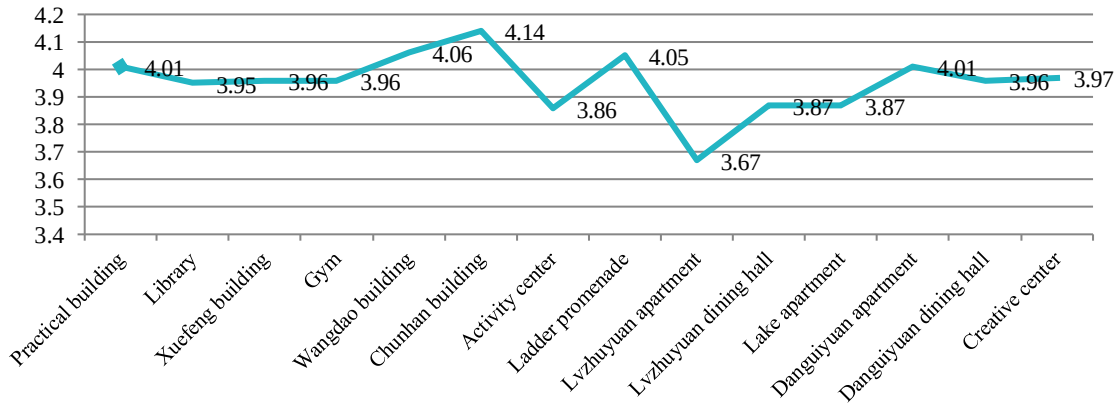

Figure 6.7 Average satisfactions of respondents to the space size of the 14 buildings.

6.3.1.2. Satisfaction of the overall campus space size

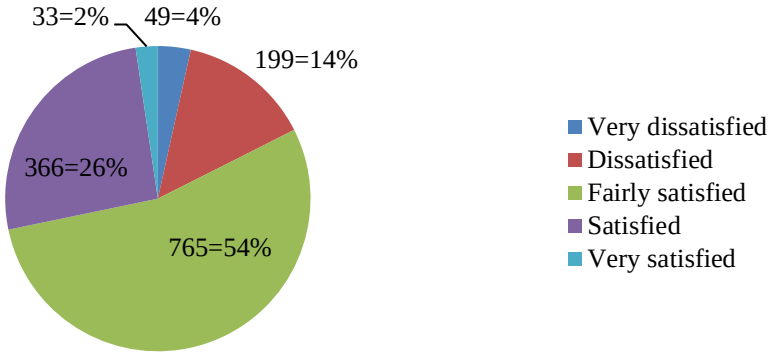

Figure 6.8 Satisfactions of respondents to the overall campus space (n=1412).

There were 765 people, 54% of the respondents chose fair satisfaction. The second choice was the group of "satisfied". But 14% and 4% chose dissatisfied and very dissatisfied respectively.

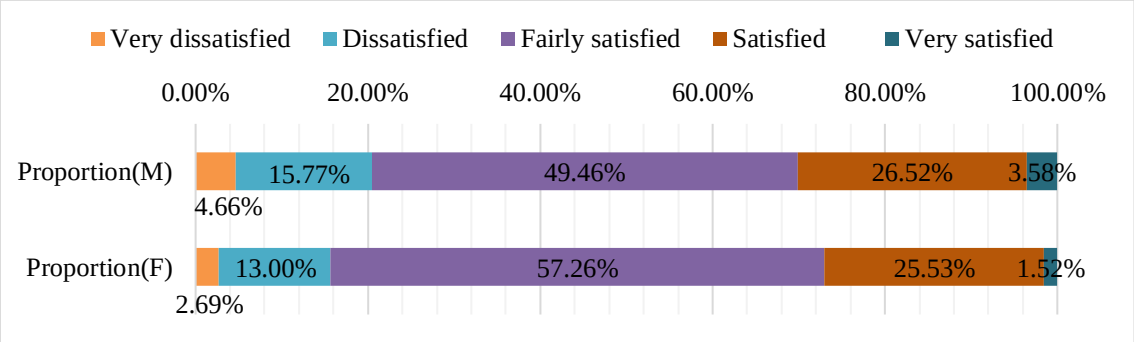

Figure 6.9 The influence of gender to the satisfaction of the overall campus space size.

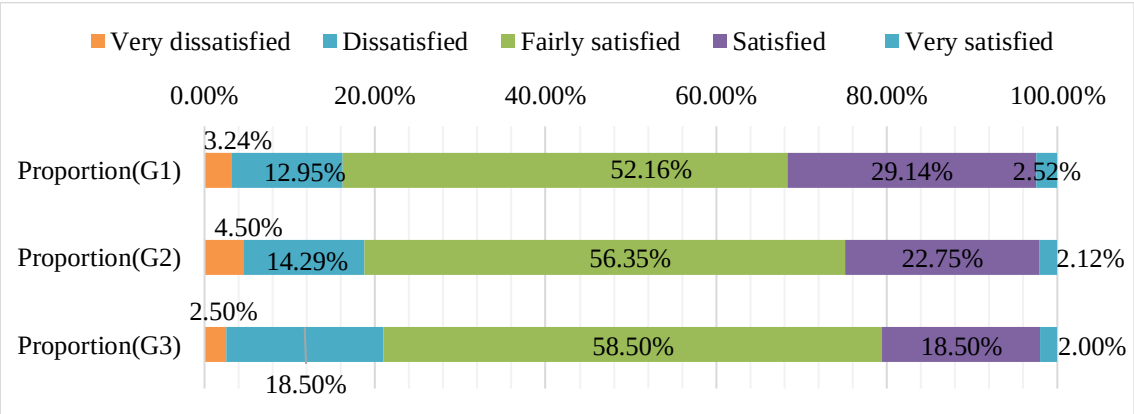

Figure 6.10 The influence of gender to the satisfaction of the overall campus space size.

In terms of gender to the satisfaction with the overall spatial scale of the campus, it can be seen from Figure 6.9 (M=558, F=854) that male respondents, 26.52% and 3.58% respectively chose satisfaction and very satisfied, higher than women's 25.53% and 1.52%. However, 15.77% and 4.66% of men chose to be dissatisfied and very dissatisfied.

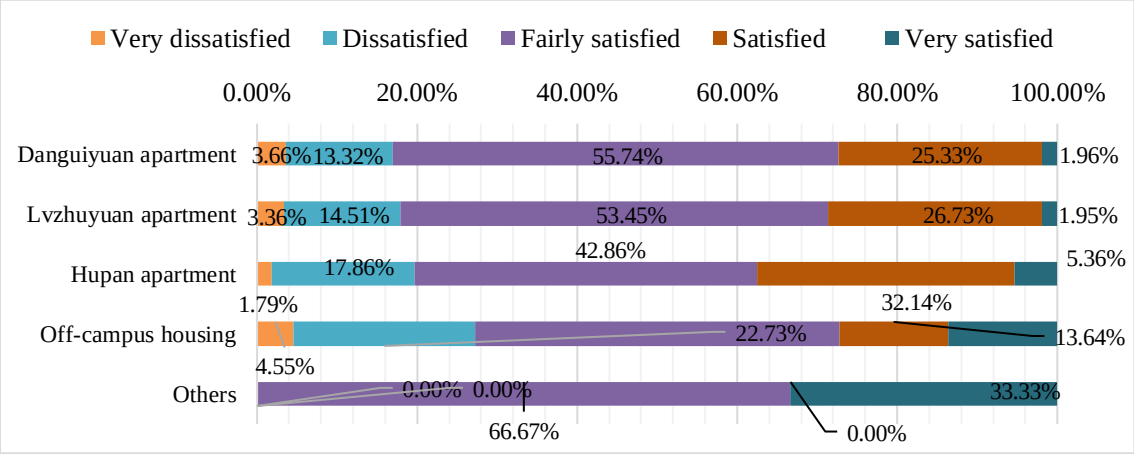

Figure 6.11 The influence of dormitories to the satisfaction of the overall campus space size.

In terms of grade to the satisfaction with the overall size of the campus, shown from Figure 6.10 (G1=834, G2=378, G3=200), Grade 1 students were very satisfied with the campus, 29.14%, significantly more than 22.75% of Grade 2, and 18.50% more than the third grade. Dissatisfaction is also significantly less than Grade 2 and Grade 3. Therefore, from the survey, the lower the grade, especially males in the lower grade, the higher the satisfaction with the overall space of the campus. Male freshmen, as a result, has a highest score.

In terms of dormitories to the satisfaction with the overall size of the campus, shown from Figure 6.11 (Danguiyuan=766, Lvzhuyuan=565, Hupan=56, Off-campus=22, Others=3), the proportion of students in Danguiyuan apartment and Lvzhuyuan apartment didn't have an obvious difference. And the students in Hupan apartment had a best satisfaction about the overall campus space size.

6.3.1.3. Satisfaction of the facilities and equipment in the 14 buildings

What do you think about the facilities and equipment in those 14 buildings? For examples, the operation machines in Practical building, the books and public computers in Library, and so on.

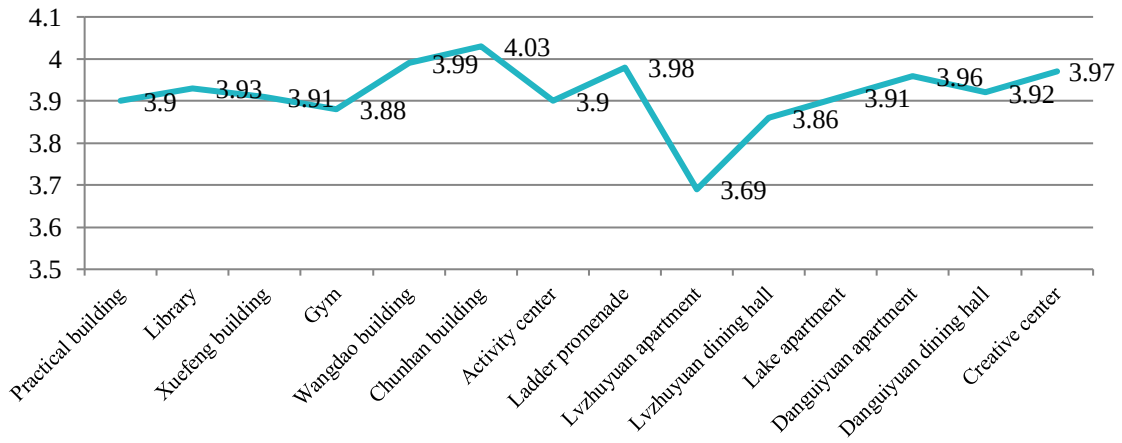

Figure 6.12 Average satisfactions of respondents to the facilities and equipments in those 14 buildings.

Table 6.6 Satisfaction of the space size of the 14 buildings.

Option	1 point	2 points	3 points	4 points	5 points	average
Practical building	52	85	331	401	517	3.9
Library	52	74	328	392	540	3.93
Xuefeng building	47	84	349	366	540	3.91
Gym	52	86	343	397	508	3.88
Wangdao building	38	66	326	397	559	3.99
Chunhan building	38	62	306	399	581	4.03
Activity center	55	73	359	368	531	3.9
Ladder promenade	46	64	327	379	570	3.98
Lvzhuyuan apartment	115	100	360	332	479	3.69
Lvzhuyuan dining hall	60	84	346	391	505	3.86
Hupan apartment	58	80	329	384	535	3.91
Danguiyuan apartment	50	65	320	409	542	3.96
Danguiyuan dining hall	51	81	326	391	537	3.92
Report hall	50	64	316	408	548	3.97
Total	1386					

As shown in Table 6.6 (n=1412) and Figure 6.12 (n=1412), the students' satisfaction with Chunhan building was the highest, with a score of 4.03, which showed that the interviewees were very satisfied with it. This is a public teaching building where students take major courses and the utilization rate is very high. Followed by Wangdao building and Ladder promenade, students scored 3.99 and 3.98 respectively, which are office buildings and small lecture halls respectively, and their utilization rate was relatively low. The worst satisfaction was Lvzhuyuan apartment, 40.01% of the respondents living in this dormitory, which can be seen that the student satisfaction about the building's facilities and equipment was very poor. The tread of the average satisfaction of respondents to the facilities and equipment is similar that of to the overall campus space size.

6.3.1.4. Satisfaction of the facilities in the overall campus

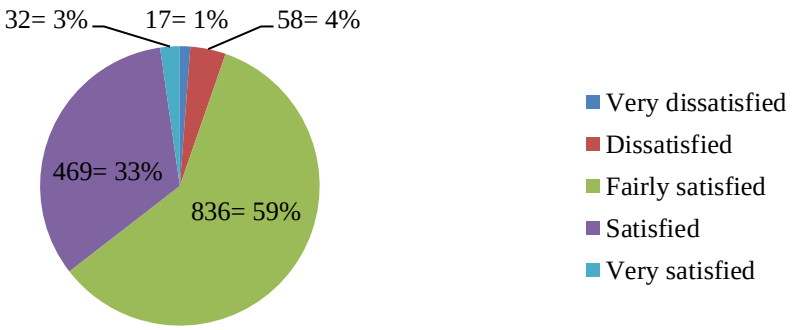

Figure 6.13 Satisfactions of respondents to the facilities in the overall campus space.

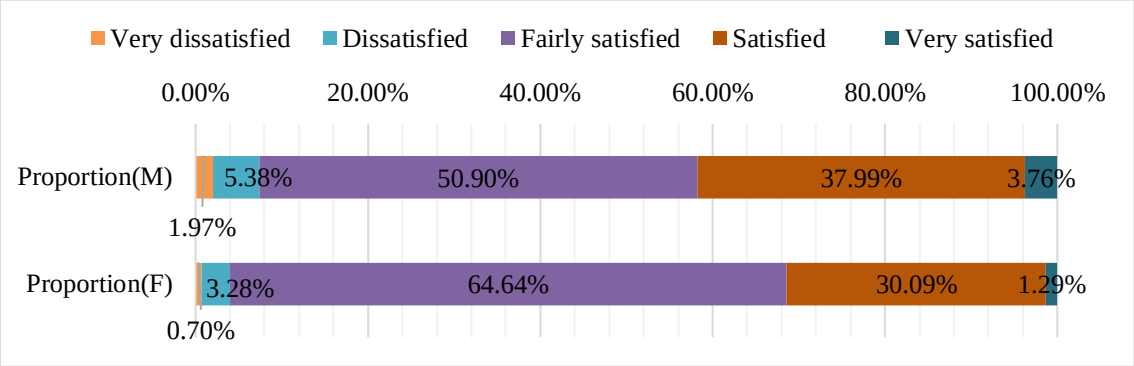

Figure 6.14 The influence of gender to the satisfaction of the facilities in the overall campus space size.

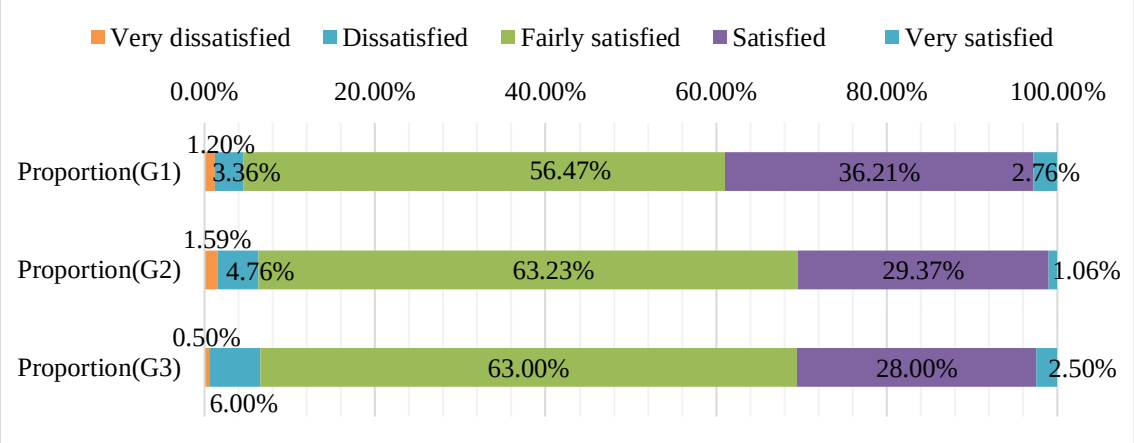

Figure 6.15 The influence of grade to the satisfaction of the facilities in the overall campus space size.

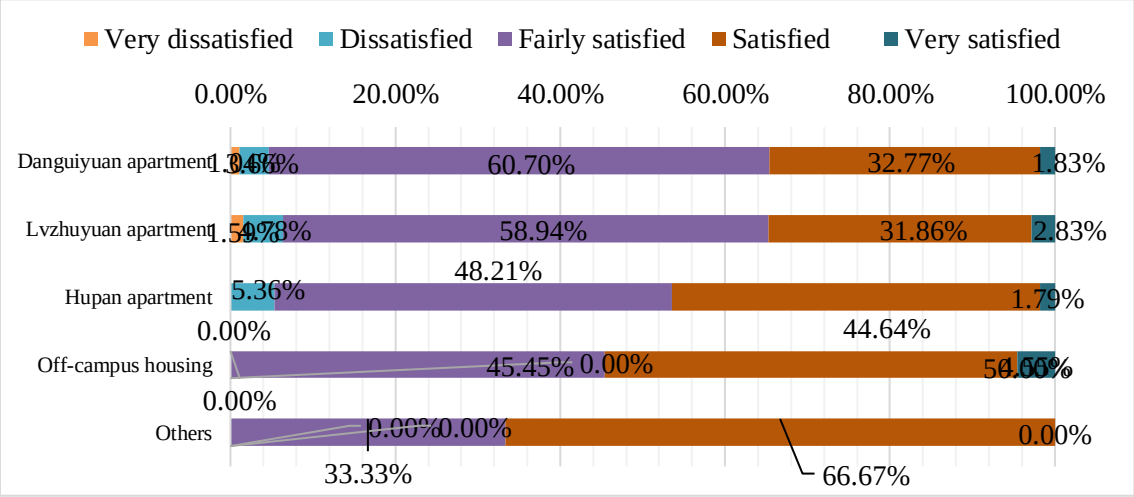

Figure 6.16 The influence of dormitories to the satisfaction of the facilities in the overall campus space size.

As for the satisfaction with campus facilities, male students were satisfied (37.99%) and very satisfied (3.76%), a total of 41.75%, which was also significantly higher than females (30.09% and 1.29% respectively, total 31.38%), shown in Figure 6.14 (M=558, F=854). At the same time, the number of

females feeling fairly satisfied is significantly higher than that of males.

As far the satisfaction with campus facilities, the proportion of Grade 1, is also significantly higher than Grade 2 and Grade 3, shown in Figure 6.15 (G1=834, G2=378, G3=200).

In terms of dormitories to the satisfaction with the overall size of the campus, shown from Figure 6.9 (Danguiyuan=766, Lvzhuyuan=565, Hupan=56, Off-campus=22, Others=3), the proportion of students in Danguiyuan apartment and Lvzhuyuan apartment didn't have an obvious difference. And the students in Hupan apartment had a best satisfaction about the overall campus space size.

6.3.2. The environment and entrance of the buildings on campus

6.3.2.1. Satisfaction of the environment of the interior cleanliness and surroundings' green spaces of those 14 buildings

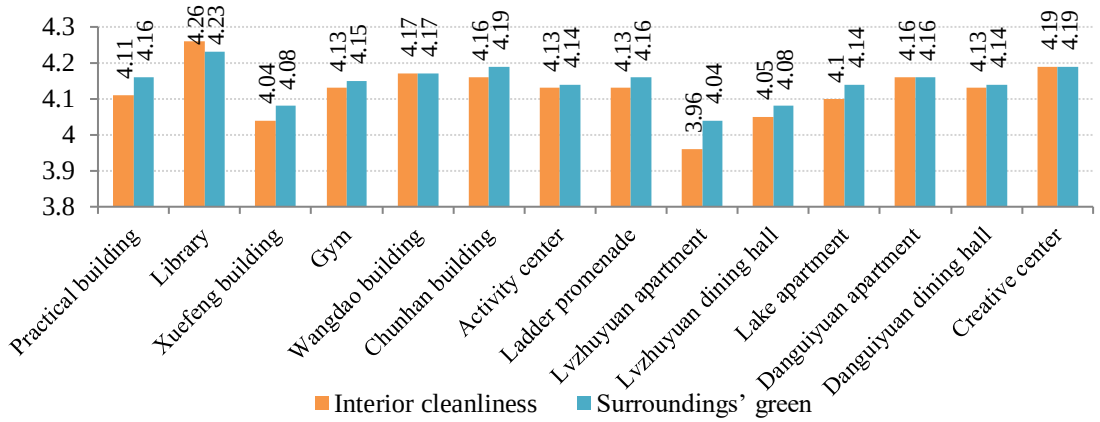

Figure 6.17 Average satisfactions of respondents to the environment of the interior cleanliness and surroundings' green in those 14 buildings.

6.3.2.2. Satisfaction of the respondents to the environments in the overall campus

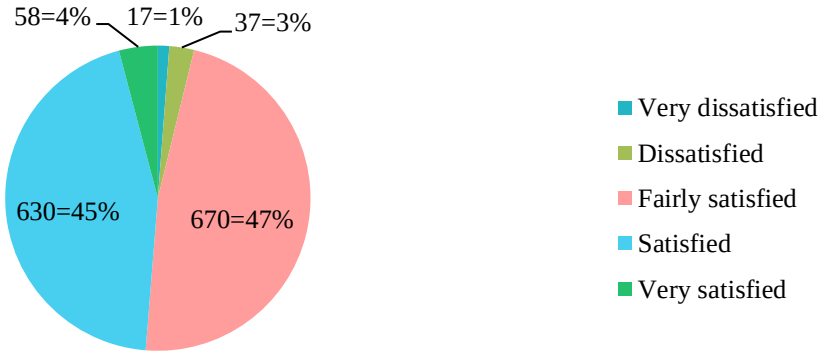

Figure 6.18 Satisfactions of respondents to the environments in the overall campus space.

As shown in Figure 6.18, for the overall satisfaction of the campus environment, 47% of the respondents thought that fairly satisfied. 45% felt very satisfied. Therefore, the fairly and very satisfied perceptions by respondents accounted for the vast majority, 92%.

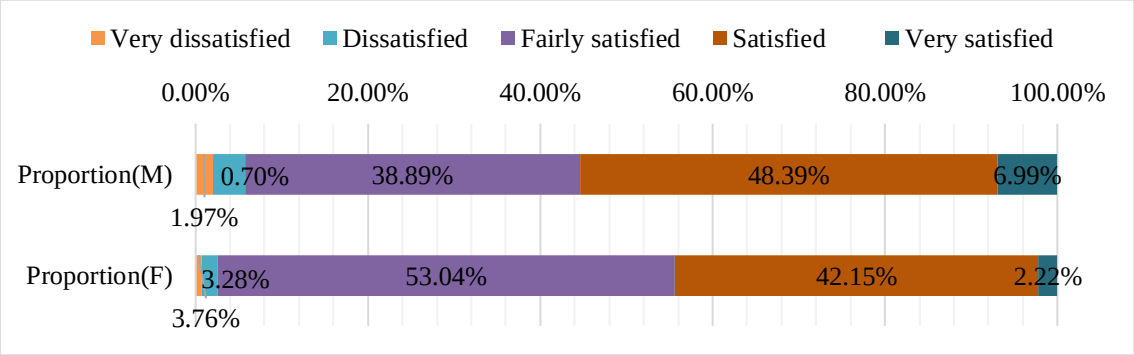

Figure 6.19 The influence of gender to the satisfaction of the environments in the overall campus space size.

Figure 6.20 The influence of gender to the satisfaction of the environments in the overall campus space size.

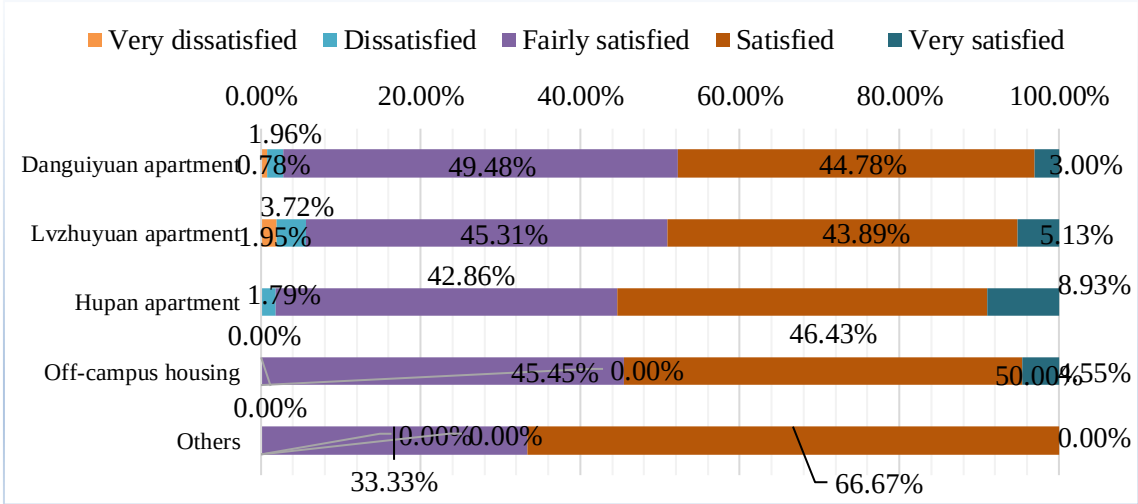

Figure 6.21 The influence of dormitories to the satisfaction of the environments in the overall campus space size.

In terms of satisfaction with the overall environment of the campus, the proportions of male respondents feeling “satisfied” and “very satisfied” were 48.39% and 6.99% respectively, 55.38% totally, significantly higher than female's 42.15% and 2.22%.

The difference in grades also has an impact on the overall environmental satisfaction of the campus. The proportion of respondents of Grade 1 feeling “satisfied” and “very satisfied” were 45.44% and 4.32% respectively, a total of 49.76%, similarly higher than Grade 2 and Grade 3.

6.3.2.3. Satisfaction of the respondents to the obvious entrance of the 14 buildings

Table 6.7 Satisfaction of the obvious entrance of the 14 buildings.

Option	1point	2 points	3 points	4 points	5 points	average
Practical building	63	86	309	367	587	3.94
Library	58	85	294	376	599	3.97
Xuefeng building	38	46	238	374	716	4.19
Gym	33	45	251	389	694	4.18
Wangdao building	48	59	267	373	665	4.1
Chunhan building	36	46	227	376	727	4.21
Activity center	84	78	310	355	585	3.91
Ladder promenade	35	28	207	364	778	4.29
Lvzhuyuan apartment	46	54	243	337	732	4.17
Lvzhuyuan dining hall	33	47	225	356	751	4.24
Hupan apartment	48	51	237	346	730	4.17
Danguiyuan apartment	34	42	218	354	764	4.25
Danguiyuan dining hall	37	50	224	360	741	4.22
Report hall	42	44	230	358	738	4.21
Total	1412					

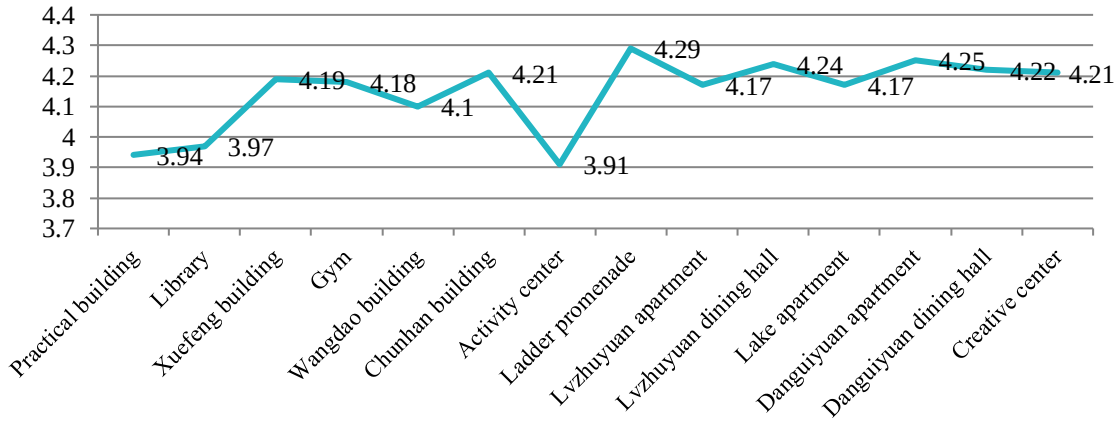

Figure 6.22 Average satisfactions of respondents to the obvious entrance of the 14 buildings.

6.3.3. The influence to space size, facilities and environment

It can be seen from Table 6.8 above that different gender samples don’t show a significant amount of space size satisfaction ($p > 0.05$), which means that there is no difference between different gender samples. However, the gender sample showed significant significance for the two items of satisfaction of facilities on campus, overall satisfaction of environment ($p < 0.05$), which means that different

gender samples have differences in satisfaction of facilities on campus, overall satisfaction of environment. Specific analysis shows (1.0 means male; 2.0 means female):

Table 6.8 ANOVA of the influence of gender to the overall satisfaction of space size, facilities and environment on campus.

ANOVA				
	Gender (Mean± standard deviation)		F	p
	1.0(n=558)	2.0(n=854)		
Space size satisfaction	3.09±0.86	3.10±0.74	0.136	0.712
Satisfaction of facilities on campus	3.36±0.73	3.28±0.58	5.508	0.019*
Overall satisfaction of environment	3.55±0.76	3.43±0.61	9.551	0.002**
* p<0.05 ** p<0.01				

Gender showed a significance level of 0.05 for satisfaction of facilities on campus (f = 5.508, p = 0.019), and the specific comparison showed that the average value of 1.0 (3.36) was significantly higher than the average value of 2.0 (3.28).

Gender showed a 0.01 level of significance for the overall satisfaction of environment (f = 9.551, p = 0.002), and the specific comparison shows that the average value of 1.0 (3.55) is significantly higher than the average value of 2.0 (3.43).

In summary, different gender samples will not show significant differences for one item of space size satisfaction, and gender samples will show significant differences for two items of satisfaction of facilities on campus, overall satisfaction of environment. The satisfaction of men is significantly higher than that of women, especially the satisfaction of the environment, which is very significant.

Table 6.9 ANOVA of the influence of grade to the overall satisfaction of space size, facilities and environment on campus.

ANOVA					
	Grade (Mean± standard deviation)			F	p
	1.0(n=834)	2.0(n=378)	3.0(n=200)		
Space size satisfaction	3.15±0.79	3.04±0.80	2.99±0.74	4.651	0.010**
Satisfaction of facilities on campus	3.36±0.65	3.24±0.63	3.26±0.63	5.647	0.004**
Overall satisfaction of environment	3.49±0.68	3.46±0.68	3.46±0.66	0.348	0.706
* p<0.05 ** p<0.01					

It can be seen from Table 6.9 above that different grade samples will not show significance for a total of 1 item of overall satisfaction of environment (p> 0.05), which means that different grade samples all show consistency for the overall satisfaction of environment, and there is no difference. However, the grade sample showed significant differences in the two items of space size satisfaction, satisfaction of facilities on campus (p <0.05), which means that different grade samples have differences in space size satisfaction and satisfaction of facilities on campus. Specific analysis shows (1.0 means students in Grade 1; 2.0 means Grade 2; 3.0 means Grade 3):

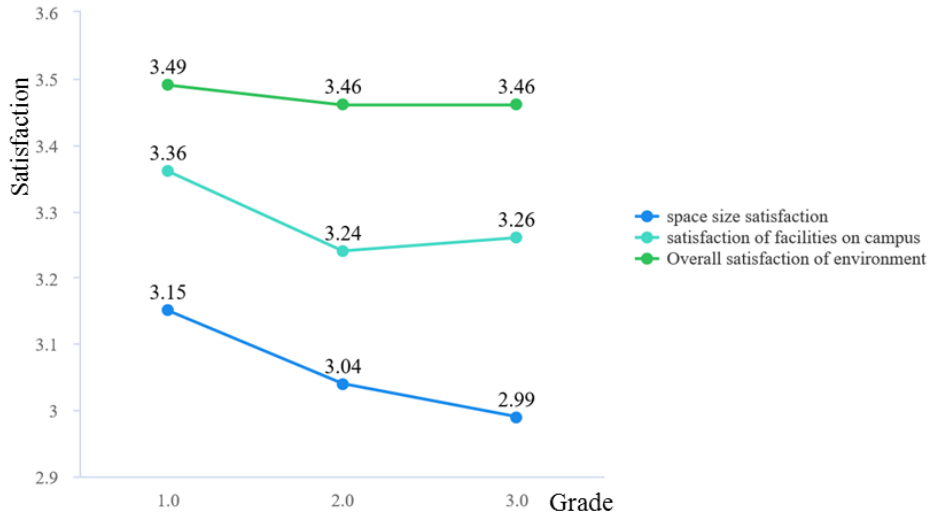

Figure 6.23 The overall satisfaction of space size, facilities and environment by different grade.

Grade showed a 0.01 level significance for space size satisfaction (f = 4.651, p = 0.010), and the specific contrast difference shows that the average score comparison result of the groups with more obvious differences is “1.0> 2.0; 1.0> 3.0” (Visual display is shown in Figure 6.23).

Grade showed a significance level of 0.01 for satisfaction of facilities on campus (f = 5.647, p = 0.004), and the specific comparison showed that the average score comparison results of the groups with significant differences were "1.0> 2.0; 1.0> 3.0" (Visual display is shown in Figure 6.23).

In summary, different grade samples will not show significant differences for 1 item of overall satisfaction of environment, and grade samples show significant differences for 2 items of space size satisfaction, satisfaction of facilities on campus. The satisfaction of first-year students on campus is significantly higher than that of second- and third-year students.

It can be seen from the above that the freshman male students have the highest satisfaction with the campus environment and overall facilities.

Table 6.10 ANOVA of the influence of dormitory to the overall satisfaction of space size, facilities and environment on campus.

ANOVA							
	Dormitory (Mean± standard deviation)					F	p
	1.0(n=766)	2.0(n=565)	3.0(n=56)	4.0(n=22)	5.0(n=3)		
Space size satisfaction	3.09±0.78	3.09±0.79	3.21±0.87	3.09±1.06	3.67±1.15	0.736	0.567
Satisfaction of facilities on campus	3.31±0.62	3.30±0.68	3.43±0.63	3.59±0.59	3.67±0.58	1.826	0.121
Overall satisfaction of environment	3.47±0.63	3.47±0.74	3.63±0.68	3.59±0.59	3.67±0.58	0.935	0.443
* p<0.05 ** p<0.01							

In summary, different Dormitory samples will not show significant differences in space size

satisfaction, satisfaction of facilities on campus, and overall satisfaction of environment. The difference in different dormitory samples will not cause the students' different satisfaction with the overall scale of campus, campus facilities and environment.

6.3.4. The usage conditions of the campus

6.3.4.1. Frequency of using the 14 buildings

Table 6.11 Frequency of staying in the 14 buildings (days per week) (n=1412)

Option	0	1 day	2 or 3 days	4 or 5 days	6 or 7 days	average
Practical building	104	221	618	278	191	3.0
Library	185	427	589	138	73	2.1
Xuefeng building	222	276	590	215	109	2.4
Gym	447	441	436	51	37	1.4
Wangdao building	238	257	582	191	144	2.5
Chunhan building	53	48	310	392	609	4.6
Activity center	927	222	195	43	25	0.8
Ladder promenade	180	230	502	169	331	3.1
Lvzhuyuan apartment	657	70	111	41	533	2.8
Lvzhuyuan dining hall	272	168	316	172	484	3.5
Hupan apartment	1148	73	74	33	84	0.7
Danguiyuan apartment	480	50	97	48	737	3.8
Danguiyuan dining hall	460	105	182	144	521	3.3
Report hall	700	253	293	87	79	1.3
Total	1412					

Usually, how many days do you totally stay in those buildings during one week? Please encircle the blank which is the most appropriate description of your time in these buildings. Based on the frequency of staying in the 14 buildings (days per week) (n=1412), there are 5 choices given to respondents. The first choice, 1.0 means stays nearly no time in the building; 2.0 means stay 1 day in this building per week; 3.0 means 2 or 3 days; 4.0 means 4 or 5 days; 5.0 means 6 or 7 days in this building per week. The detail of staying in buildings can be seen in Table 6.11.

Table 6.12 ANOVA of the influence of gender to the average usage days in Library, Gym and Activity center.

ANOVA				
	Gender (Mean ±standard deviation)		F	p
	1.0(n=558)	2.0(n=854)		
Days-Library	2.60±1.06	2.66±0.96	1.341	0.247
Days-Gym	2.32±1.08	2.03±0.91	30.171	0.000**
Days-Activity center	1.79±1.12	1.47±0.80	38.617	0.000**
* p<0.05 ** p<0.01				

It can be seen from Table 6.12: different gender samples will not show significant differences for a total of days-library items (p> 0.05), and gender samples will show significant differences for a total of days-gym and days-activity center items (p <0.05). Specific analysis shows that gender showed a 0.01 level significance (f = 30.171, p = 0.000) for days-gym, and the specific comparison difference shows that the average value of men (2.32) is significantly higher than the average value of women (2.03). Gender showed a 0.01 level significance (f = 38.617, p = 0.000) for the days-activity center, and the specific comparison showed that the average value of men (1.79) was significantly higher than the average value of women (1.47). Men spend significantly more time than women in gyms and student activity centers.

Table 6.13 ANOVA of the influence of satisfaction of facilities on campus to the average usage days in Library, Gym and Activity center.

ANOVA							
	Satisfaction of facilities on campus (Mean ±standard deviation)					F	p
	1.0(n=17)	2.0(n=58)	3.0(n=836)	4.0(n=469)	5.0(n=32)		
Days-Library	2.53±1.18	2.45±1.26	2.63±1.01	2.65±0.92	3.03±1.09	1.872	0.113
Days-Gym	2.41±1.12	1.98±1.24	2.07±0.96	2.25±0.98	2.69±1.28	5.519	0.000 **
Days-Activity center	2.35±1.69	1.62±1.07	1.55±0.91	1.61±0.92	2.22±1.39	6.767	0.000 **
* p<0.05 ** p<0.01							

As can be seen from the table above: different satisfaction of facilities on campus samples will not show significance for a total of 1 Days-Library (p> 0.05), which means that different satisfaction of facilities on campus samples will all show Days-Library Consistency, there is no difference. In addition, the satisfaction of facilities on campus sample showed significant results for 2 items (Days-Gym, Days-Activity center) (p <0.05), which means that different satisfaction of facilities on campus samples have differences for Days-Gym, Days-Activity center. Specific analysis shows (1.0 means Very dissatisfied; 2.0 means dissatisfied; 3.0 means fairly; 4.0 means satisfied; 5.0 means very satisfied):

Satisfaction of facilities on campus showed a level of significance of 0.01 for Days-Gym and Days-Activity center (F = 5.519, p = 0.000; F = 6.767, p = 0.000), and specific comparisons show the groups with more significant differences, that the comparison results of different average scores are: students who are often in the gym or activity center are often those who choose to be very satisfied (satisfaction degree of 5) and very dissatisfied (satisfaction degree of 1). And if you don't spend enough time in the gym and activity center, you will often give intermediate satisfaction. As shown in the line chart (Figure 6.24).

Figure 6.24 The influence of satisfaction of facilities on campus to the average usage days in Library, Gym and Activity center.

6.3.4.2. Behavior after the meal in canteen

Regarding the habitual behavior after the meal in canteen, the first choice was “direct back to your dormitory to rest and play”, with a total of 559 respondents,41% choosing. The second needed choice was “buying snacks in the school supermarket, cake shop of fruit shop”, with 26%, 355 people choosing. Next was “walking and rest in the playground and grass”, “walking around the campus” and others. Besides, 4% of students choose to go to the student union or club activities after dining, and only 1% of students choose to go to have off-campus activities. Therefore, it is very necessary to design the dormitory and supermarket next to canteen.

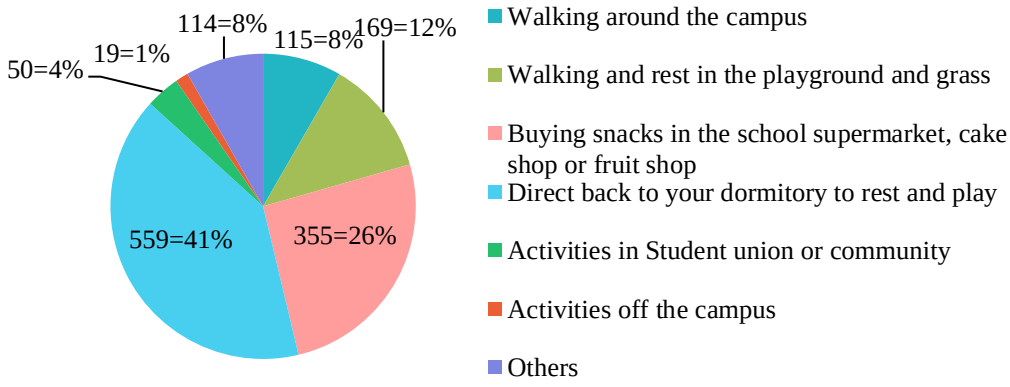

Figure 6.25 Respondents’ usually choosing behavior after the meal in canteen.

As shown in Figure 6.25, regarding the habitual behavior after the meal in canteen, the first and second choice of respondents of different genders, were respectively “direct back to your dormitory to rest and play”, and “buying snacks in the school supermarket, cake shop of fruit shop”.

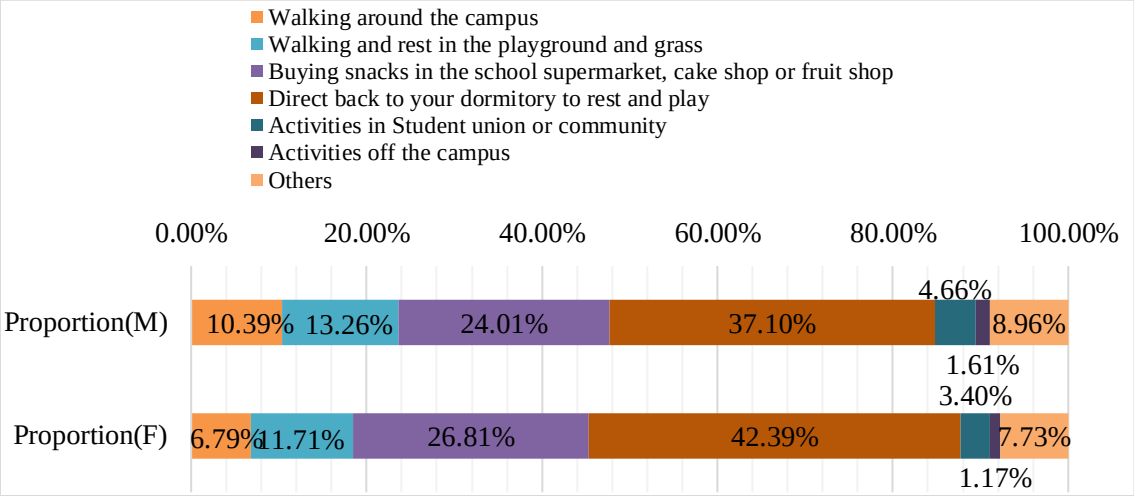

Figure 6.26 The influence of gender to respondents' usually choosing behavior after the meal in canteen.

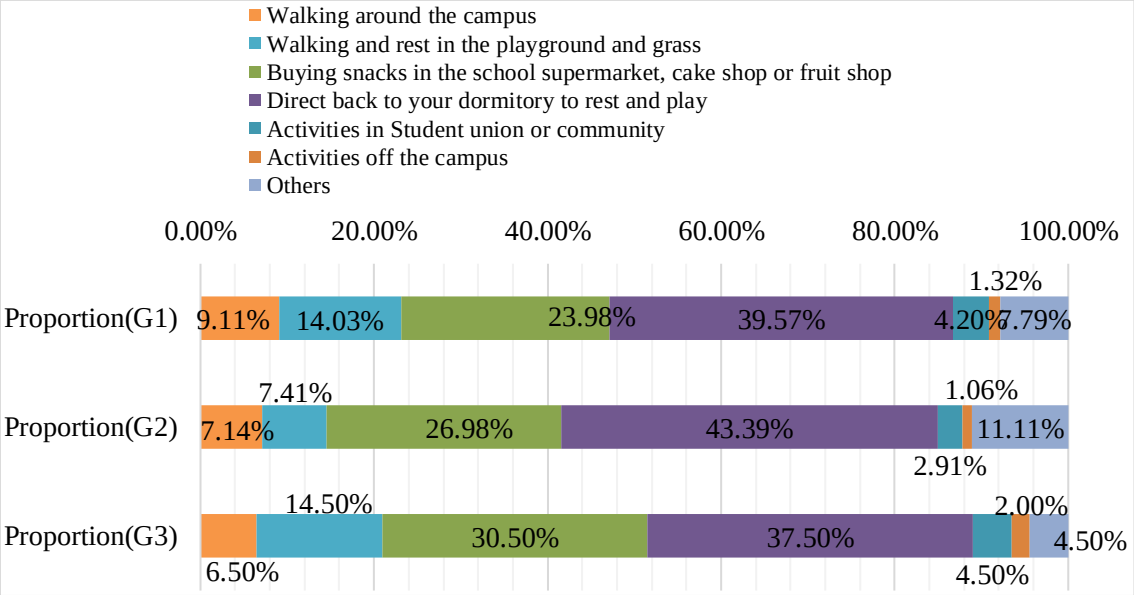

Figure 6.27 The influence of gender to respondents' usually choosing behavior after the meal in canteen.

Regarding the habitual behavior after the meal in canteen, the first and second choice of respondents of different genders, were respectively "direct back to your dormitory to rest and play", and "buying snacks in the school supermarket, cake shop of fruit shop". As can be seen in Figure 6.26, the influence of gender to respondents' usually choosing behavior after the meal in canteen are compared. And the proportion of females, 42.39% and 26.81%, were higher than males' 37.10% and 24.01 %.

In Figure 6.27, the influence of gender to respondents' usually choosing behavior after the meal in canteen can be seen. However, the difference is not so obvious. The proportion of students in Grade 2 are more easily to choose "direct back to your dormitory to rest and play", and "buying snacks in the school supermarket, cake shop of fruit shop".

In Figure 6.28, The influence of dormitories to respondents' usually choosing behavior after the meal in canteen can be seen. Similarly, as respondents living in different dorms chose "direct back to your dormitory to rest and play", and "buying snacks in the school supermarket, cake shop of fruit shop" much more. The proportion of students in Danguiyuan apartment who chose these two items were 42.69% and 26.24%, were significantly higher than those of Lvzhuyuan and Hupan apartment.

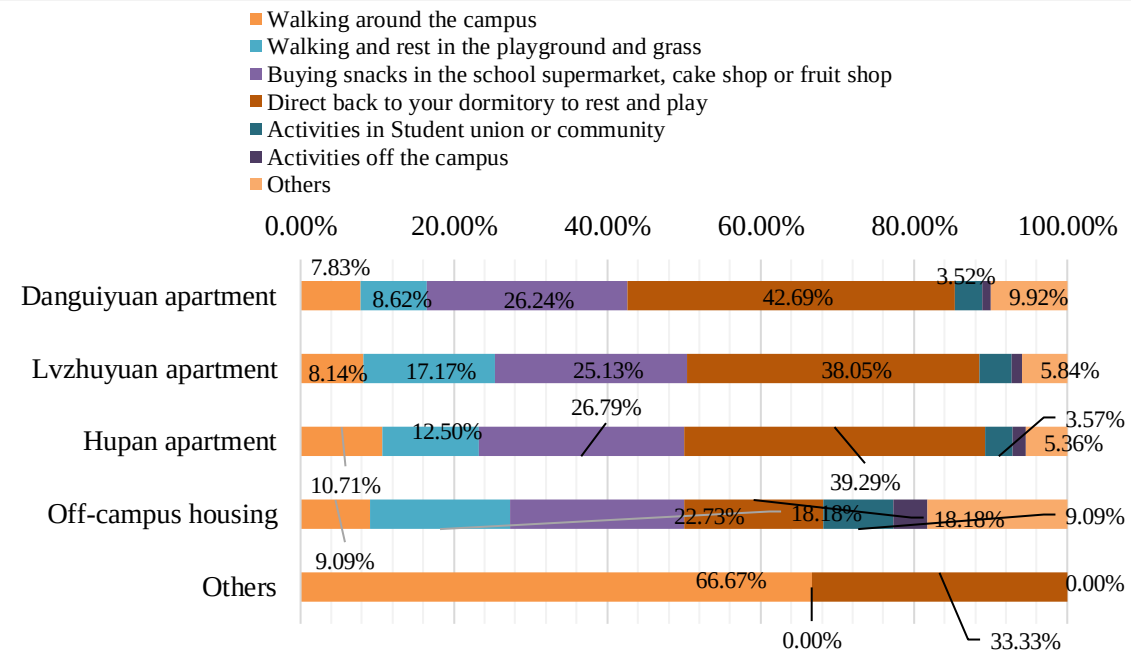

Figure 6.28 The influence of dormitories to respondents' usually choosing behavior after the meal in canteen.

Table 6.14 ANOVA of the influence of dormitory to students' activity after dinner.

ANOVA							
	Dormitory (Mean ±standard deviation)					F	p
	1.0(n=766)	2.0(n=565)	3.0(n=56)	4.0(n=22)	5.0(n=3)		
Activity after dinner	3.69±1.48	3.41±1.40	3.39±1.41	3.86±1.96	2.00±1.73	4.308	0.002**
* p<0.05 ** p<0.01							

As can be seen from Table 6.14 above: different dormitory samples all show significant significance for activity after dinner ($p < 0.05$), which means that different dormitory samples have differences for activity after dinner. Specific analysis shows that: dormitory showed 0.01 level of significance for activity after dinner ($f = 4.308$, $p = 0.002$). Students in different dormitories have obvious differences in choosing activities after meals. And Students living in Danguiyuan apartment with relatively poor accessibility have the highest percentage of "direct back to your dormitory to rest and play", and "buying snacks in the school supermarket, cake shop of fruit shop". This may be because the dormitory is not closely connected with the surrounding environment, which makes it easier for students to return directly to the dormitory. The main activities of students on campus, indicated in Figure 6.3, also prove

that the proportion of students who choose to have activities in dormitories is the highest than in other dormitories.

Different genders have no significant effect on the main activities performed after meals

6.3.4.3. The choice of exercising place

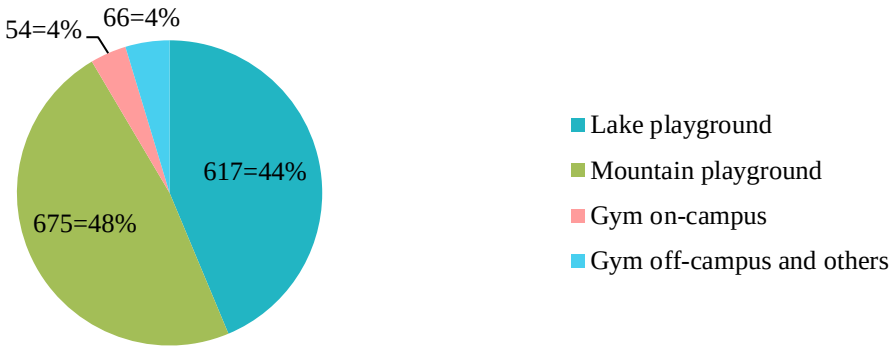

Figure 6.29 Respondents' choice of exercising place.

In Figure 6.29, respondents' choices of exercising place are shown. 48% of students chose to play in the Mountain playground, and 44% of students chose to play in the Lake playground, which accounts for 92% of the total, showing the importance of playgrounds. Only 4% of students chose to exercise in Gym, which may be caused by its location, and the accessibility is relatively low. At the same time, students prefer to running, but the gym also lacks the venue for this sport.

6.3.4.4. Frequency of going to the exercising place

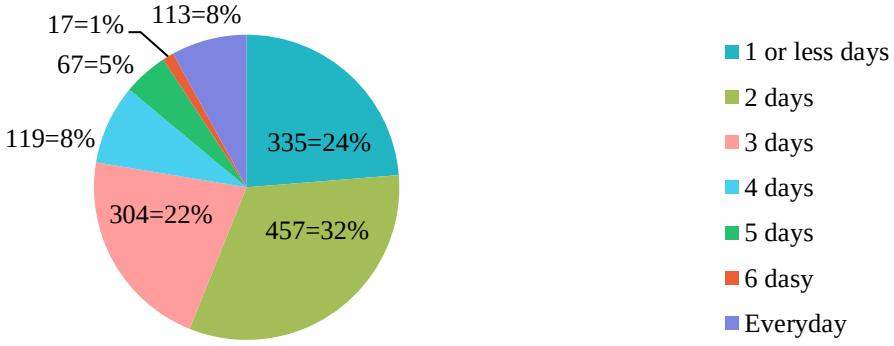

Figure 6.30 Respondents' frequency of going to the exercising place (days per week).

Figure 6.30 shows the respondents' frequency of going to the exercising place (days per week). The proportion of respondents who do exercise 2 days a week, 335 persons, accounting for 32%, is the largest. Followed by those who exercise 1 day or less day per week, accounting for 24%. And next is followed by people who exercise three days a week, accounting for 22%. Therefore, the proportion of exercise days no more than 3 days per week accounted for 78%.

6.3.4.5. The reasons of choosing exercising place (4 choices at most)

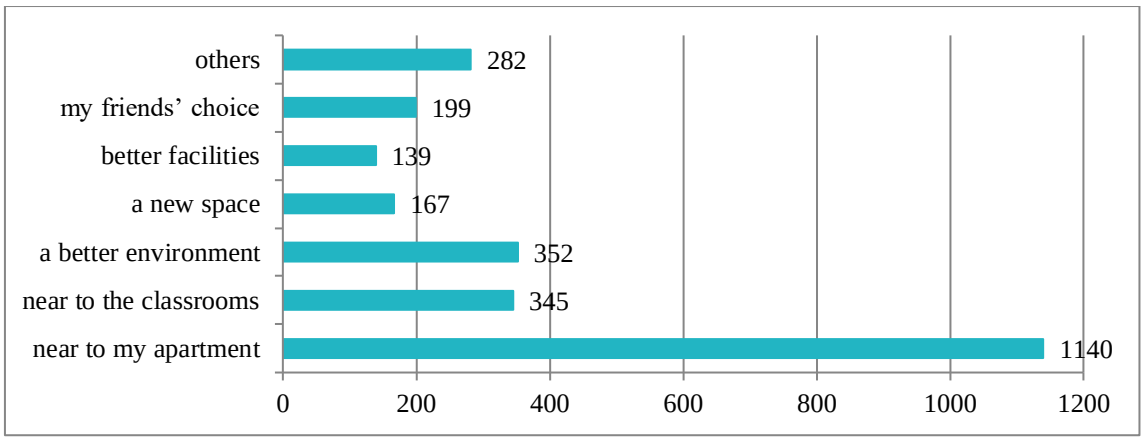

Figure 6.31 The reasons of choosing exercising place.

As can be seen in Figure 6.31 (4 choices at most, n=1412), it is very obvious that the first choice for respondents to choosing exercising place is "near my apartment", with 1140, 80.74% choosing this reason. Followed by the reason of "a better environment", and "near to the classrooms" (to facilitate after class exercise), there were respectively 352 and 345 students choosing, which is much less than the reason of near to my apartment. From this survey, we can see that the dormitory position plays a huge role in the selection of activities for students.

This is a good proof that if the exercising place is close to the dormitory, students will be more willing to walk out of the dormitory and participate in sports or outdoor activities, which, when planning the new campus, should be paid more great attention to. Set up the exercising place, especially playgrounds, around the dormitory. As shown in Figure 6.29, students are more willing to go to the playground to exercise. In addition, the playground near the teaching area can be fully utilized and students can go for a walk or other physical exercise after the class. In addition, a good sports environment is also very important. Therefore, after planning the location of the stadium, subsequent maintenance is also essential.

Chapter 7.
Analysis on the accessibility of main building spaces based on Space syntax

7.1. Introduction of public green space's accessibility

Accessibility refers to the ease of access to services, activities, and destinations, known as the "potential of opportunities". An accessible transportation system can be defined as one that enables individuals to reach their destinations. An accessibility-based analysis can lead to better solutions to connection problems by providing benefits and congestion reduction in cost- effective ways. Access

Figure 7.1 Axial line analysis of YWICC based on Space syntax

to public spaces has become a major issue in many cities in recent years. Accessibility concerns both non-disabled and disabled people, so all users benefit when the main routes are made accessible, as well as the need to make access attractive.

How is the accessibility of main public buildings calculated in this study? There are often multiple entrances in one building, and the accessibility of the road where each entrance is located is the accessibility of the building. It also means that the global integration value of the building's entrance is the global integration value of the building. As for buildings with multiple entrances, the integration value also corresponds to multiple. The largest value is the maximum integration value of the building, and the smallest value is the minimum integration value of the building. Based on Space syntax theory, the integration degree value calculated by the DepthMap software can be used to obtain the building's accessibility index.

7.2. Integration of main building spaces

7.2.1. Axial line analysis

According to the spatial perception, divide the large-scale space into a series of small-scale space. The relevant index of each axis represents the convenience of movement, transfer, forward and other capabilities. And travel along the axial direction is the most economical and convenient movement6). As shown in Figure 7.1, the black lines are axial lines analyzed by Space syntax theory.

In modeling, need to follow the spatial syntactic theory, the main point of drawing about the axis diagram: the "longest and only line" that traverses a space. In addition, the axis of the ground floor, and the upper road network system have their own topological relationship between the upper and lower layers, which do not actually intersect in the three-dimensional space, but may intersect in the two-dimensional weekly line graph. After importing the DepthMap software, need to process these intersections and use the unlink command to separate the two as shown in Figure 7.2.

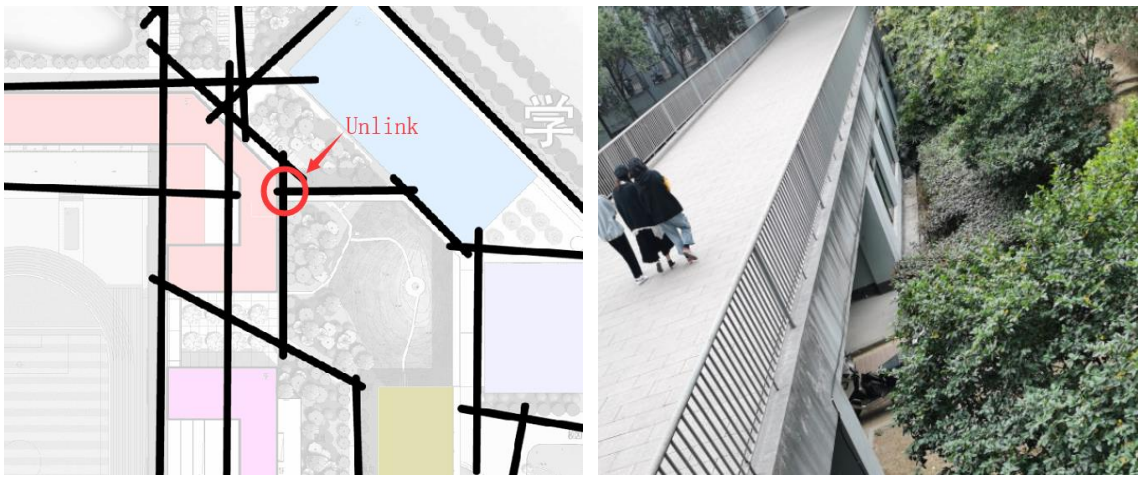

Figure 7.2 The topology relationships in DepthMap

7.2.2. Integration value analysis

The graph is based on Space syntax theory, and the axial map of the entire campus is imported into the global integration value calculated by DepthMap software. We can see the entire campus in Figure 7.3 (Source: own illustration, based on data from Yiwu Industrial and Commercial College, 2018). It is obvious that the most integrated areas are concentrated on 4 lines. The most reachable Road-1 global integration value is 1.509. In fact, the road named Hangda Road is the main road in the school and also the earliest road when YWICC was established. After more than two decades of development, along this main road, many buildings and the rest of the roads have been planned. The calculation results of the spatial syntax are also in full compliance with the actual use of the campus. This road is the most accessible place in the whole school, and it is also the place with the highest utilization rate. According to the on-site investigation, it has the largest traffic volume. As shown in Figure 7.4, the

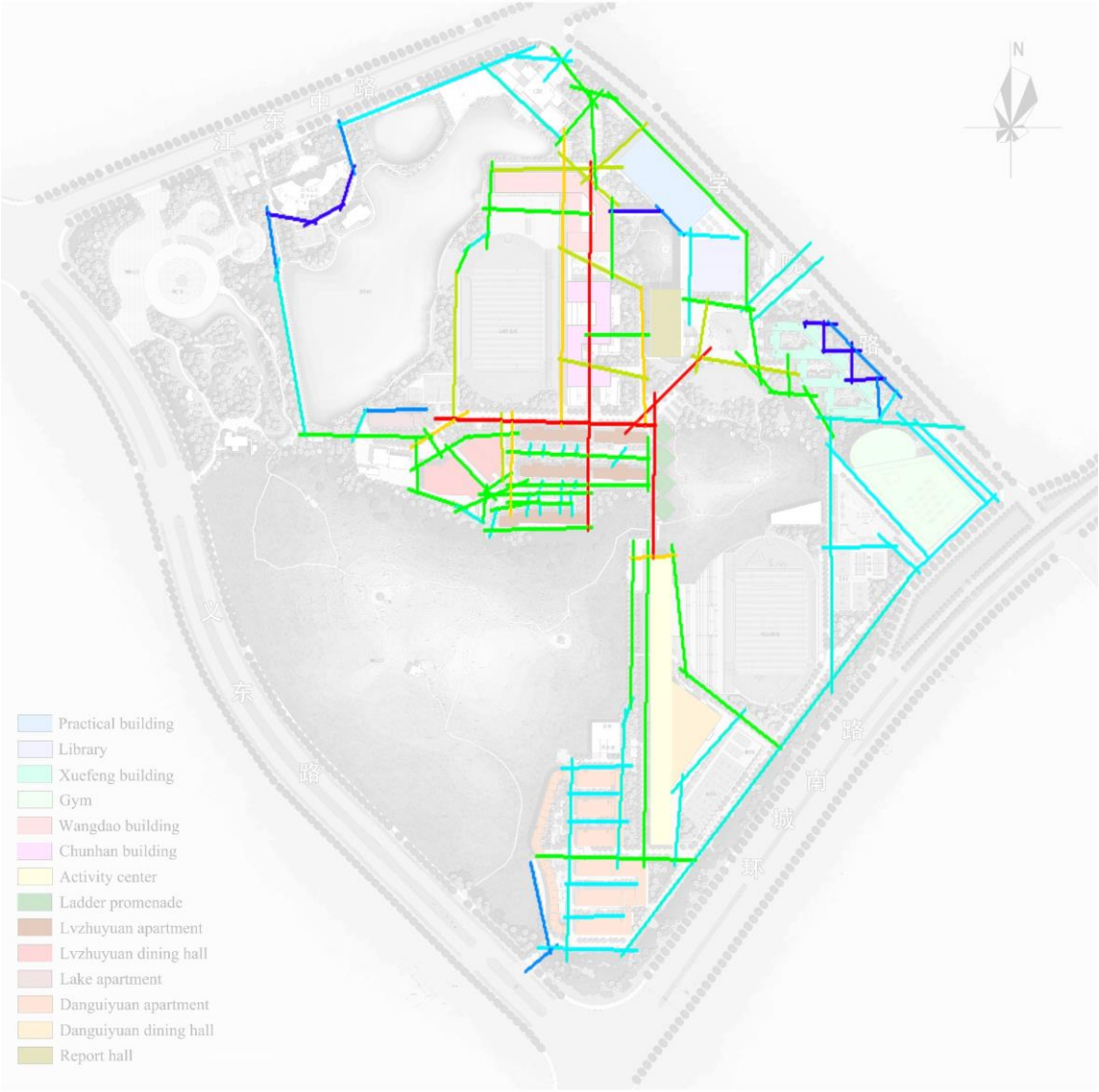

Figure 7.3 The global integration (Rn) of spatial structure of YWICC.

second road with global integration value (Road-2) is the road before connecting the main square and the main road. The global integration value is 1.211. This is from the cafeteria, dormitory, or teaching building to the library, Xuefeng Building, and Report hall, the most convenient way of the hall. The third place with global integration is Road-3, 1.366, which is the road connecting the campus's main road, road-1, and the school building Chunhan building. This road is located on the overhead floor of the Chunhan building. Although it is difficult to reflect on the map, it actually plays an important role in the connection of the entire space. The fourth level of global integration, road-4, 1.362, is connected to road-1 and road-2, and also leads to the classrooms, Activity center and Danguiyuan dormitory. The on-site inspection is available. This is the only way for Danguiyuan students to go to the teaching building, so the actual utilization rate is quite high.

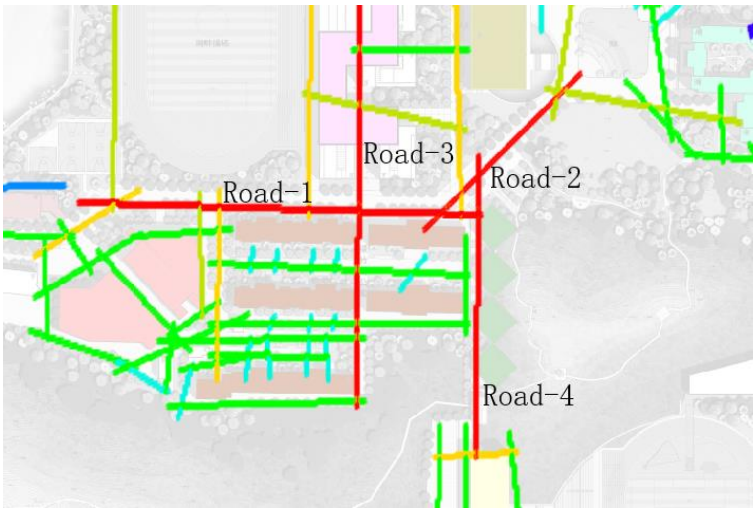

Figure 7.4 The 4 roads with relatively high Int. V based on analysis of DepthMap software.

These roads have also become a road with a high degree of full concentration on the whole campus. From the spatial layout, this area is also the central area of the campus space, with a complete road system and clear spatial structure. Thus, it forms a combined core in the spatial structure, which means that it has the strongest space penetration and integration power, representing the most central area in the syntactic sense, and the most dynamic place.

According to the accessibility of the road connected with the building space, the global integration value of the corresponding building space is given. The global integration value and local integration of the roads with the maximum accessibility are shown in Table 7.1. We can see that Chunhan building is the place with the highest global integration value, that is, the building with the best global accessibility. Chunhan building is the public teaching building, which students' satisfaction with is the highest, no matter space size, environment or the facilities. The public teaching building with a highest accessibility is very convenient for students to have classes, but it also occupies other buildings' space, which are important but not having to be used by students, such as libraries, gyms and so on.

Table 7.1. The integration value of spatial structure of 14 main building spaces analyzed by Space syntax.

Buildings	Global Int.V (Rn)		Local Int.V (R3)	
	Maximum	Minimum	Maximum	Minimum
Practical building	1.019	0.612	1.669	0.887
Library	1.019	0.708	1.750	0.887
Xuefeng building	0.797	0.478	1.791	0.690
Gym	0.797	0.692	1.791	1.394
Wangdao building	1.335	0.538	3.103	0.333
Chunhan building	1.509	0.930	3.103	1.422
Activity center	1.075	1.045	1.479	1.273
Ladder promenade	1.211	1.075	1.569	1.479
Lvzhuyuan apartment	1.384	0.868	3.103	1.417
Lvzhuyuan dining hall	1.153	0.907	2.060	1.784
Hupan apartment	1.509	0.683	2.624	0.499
Danguiyuan apartment	0.976	0.693	2.099	1.070
Danguiyuan dining hall	1.075	0.796	1.569	1.095
Report hall	1.228	0.837	1.949	1.224

In Table 7.1 and Figure 7.5, the global integration value (Global Int. V) and local integration value (Local Int. V) of the 14 main buildings are shown. Both the global integration value and local integration value of Wangdao building and Chunhan building are very high, which means that they have a good accessibility throughout the school. It also indicates that the topological distance of three steps are tightly connected. Followed by Lvzhuyuan apartment and Hupan apartment, their global and local integration values are also high. Because they are around Road-1, which is the road with the highest global integration value.

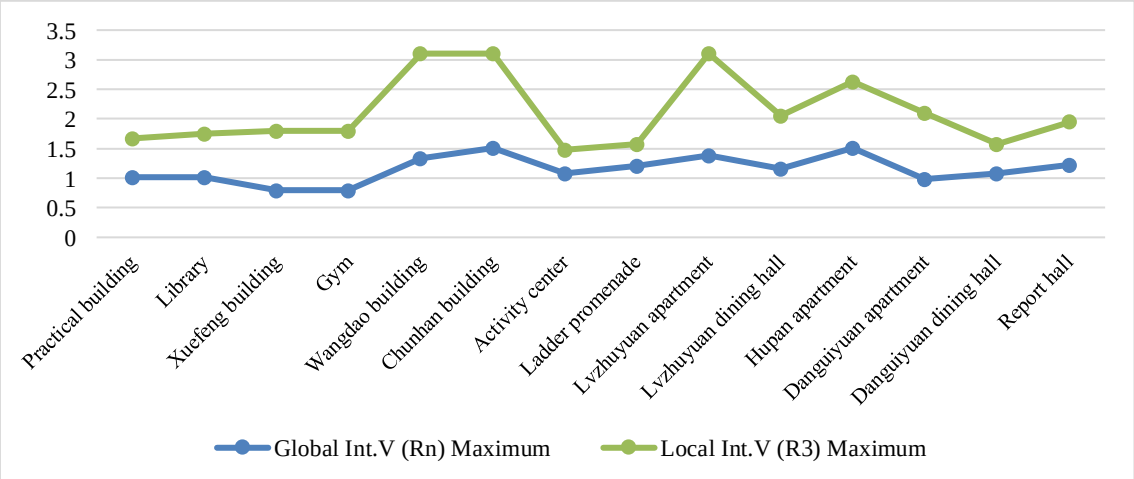

Figure 7.5 The maximum Global Int. V (Rn) and maximum Local Int. V (Rn) of main building spaces of YWICC analyzed by Depthmap software based Space syntax theory.

However, the lowest global integration value is the Xuefeng building and the Gym. The roads where their entrances are located have the lowest global accessibility, although they are close to the school's main entrance. Finally, Activity center with the lowest local integration value is not closely related to the surrounding environment, the utilization rate of which is also very low and consistent with the actual situation.

As can be seen from Figure 7.5 above, the trend of the global integration degree value of the main buildings of the campus and the trend of the local integration degree value are roughly consistent. The values of global integration and local integration are high in Wangdao building, Chunhan building, Lvzhuyuan apartment and Hupan apartment. This also shows that the local roads and the overall roads of the entire campus are well connected, and there is no high local accessibility but with low global accessibility.

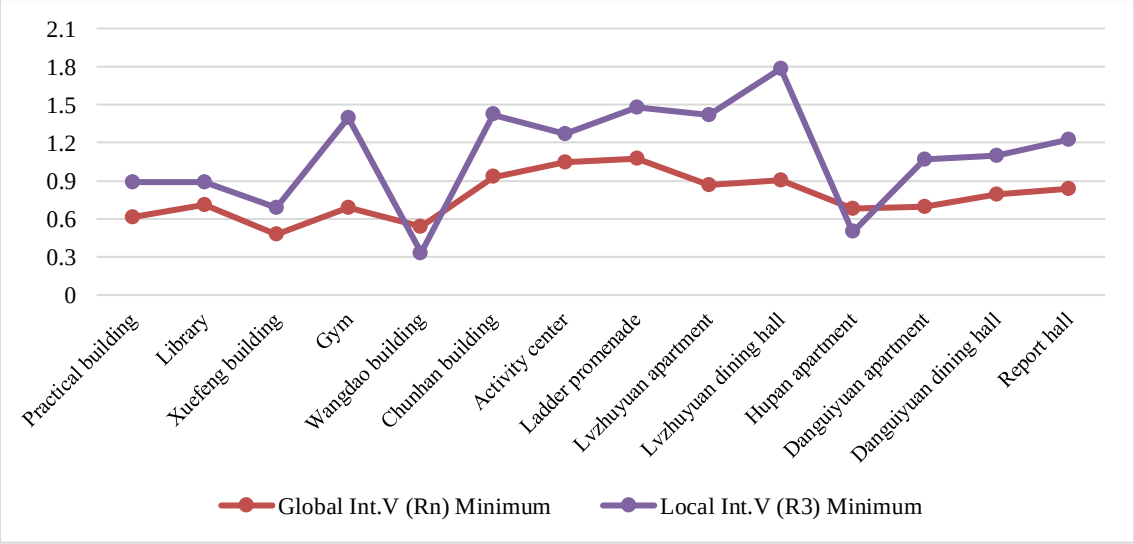

Figure 7.6 The minimum Global Int. V (Rn) and minimum Local Int. V (Rn) of main building spaces of YWICC analyzed by DepthMap software based Space syntax theory.

Similarly, as shown in Figure 7.6, for the entrance with a lower accessibility integration of the main building on the campus, its global integration value and local integration value tend to be roughly consistent. The exception is Wangdao building and Hupan apartment. The local integration value of their poorly reachable entrances is very low, which also reflects that their connection to the surrounding space is not good enough, and the integration value is urgently needed to achieve better accessibility.

Looking at local integration (R3), as shown in Figure 7.7, we can see that the pattern was very similar: the highly integrated areas appeared tightly connected with the campus, and often exchanged with locally non-integrated areas. Thus, some spaces emerged as being locally accessible which were also at the global level. According to this, the Local Int.V of the other spaces were roughly the same rank as the Global Int.V. Hangda road, the central road with a best local accessiblity, which connect well with iits syrroundings at the level of three topological steps.

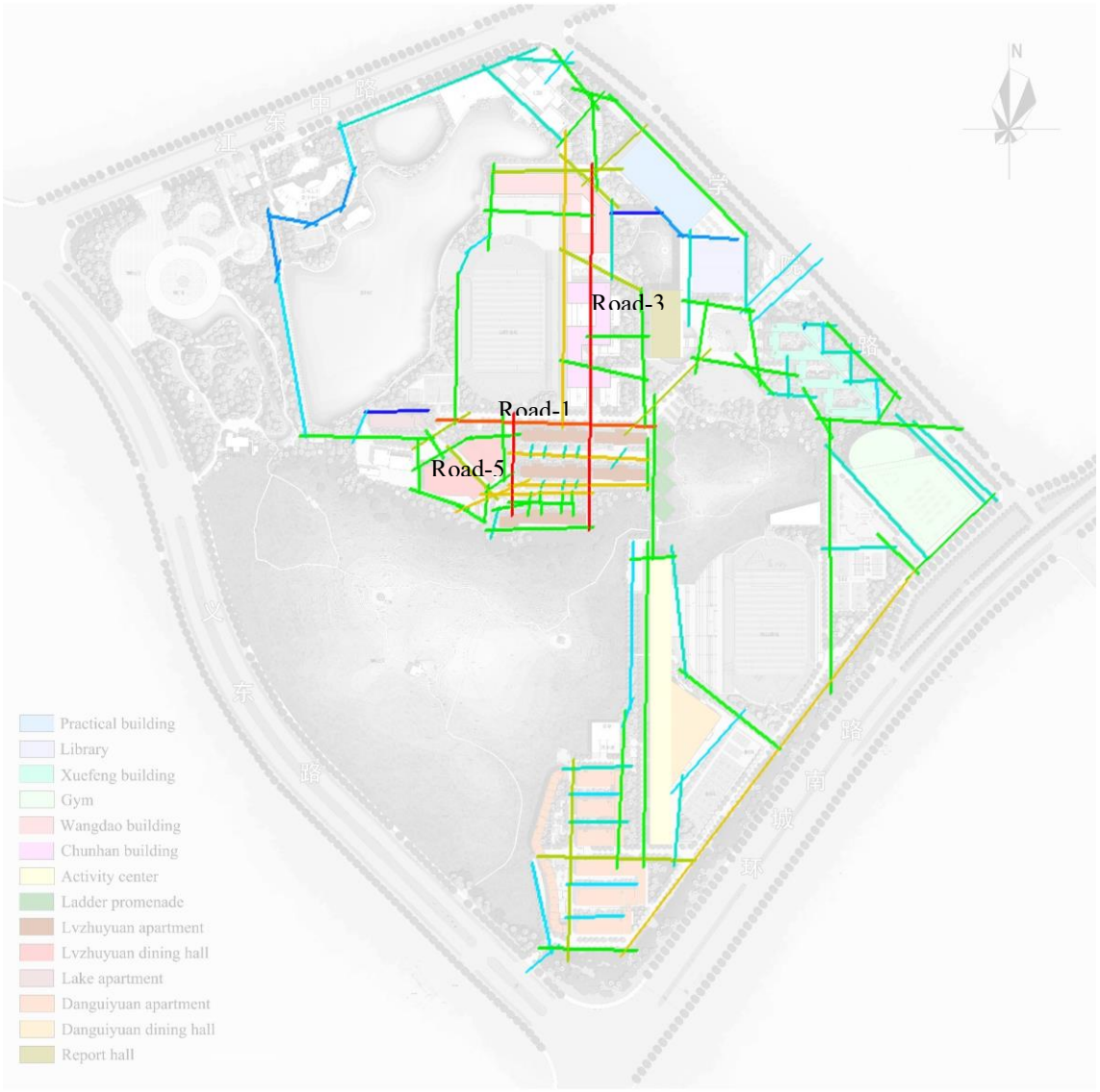

Figure 7.7 The local integration (R3) of spatial structure of YWICC.

As shown in Figure 7.7 (Source: own illustration, based on data from Yiwu Industrial and Commercial College, 2018), the result is obtained after calculating the local integration using DepthMap software based on Space syntax theory. It can be seen that the red area is concentrated in the center of the campus, and the area consisting of Road-1, Road-2 and Road-3 is the place with the best local accessibility, which means that students can easily move around. However, the local accessibility of the other areas is relatively poor. Around the Xuefeng Building and around the Gym, the blue axis indicates that it is not closely connected with the surrounding area, also as Danguiyuan apartment. This may explain why the students of Danguiyuan Apartment are more inclined to stay in their dormitory, and they prefer to go directly to the dormitory after meals or choose to buy some snacks in the supermarket and return. Danguiyuan Apartment is more like a cross-accessibility living group, resulting in students not being closely connected with other places.

7.3. Impact of accessibility of main building spaces

7.3.1. Impact of integration on convenience of main building spaces

According to the collected questionnaires, we analyzed the problem that "Do you think those 14 buildings convenient to reach this building from your apartment, and any other buildings connect with these buildings?", and the results were shown in Figure 7.8. Throughout the green spaces, students generally felt that it was relatively convenient to go from the main entrance to anyone of them. Space-1 had the highest score of 4.76, obviously because of its position of nearest from the main entrance. Then space-2, a satisfaction of 4.40, was the secondly convenient public green space from the main entrance, which can be seen from the whole campus map. Space-6 was the farthest from the main entrance, thus it had the least convenience satisfaction of 2.67. Conversely, from the dormitory, the students found space-6 to be the most convenient, scoring 2.95, because it was closest to their dormitories. Furthermore, from anywhere of the campus to the green spaces, respondents considered that space-5 was the most convenient, with a satisfaction of 3.84, and space-1 was the most inconvenient, with a score of 3.46, which was consistent with the accessibility of Space syntax theory. As indicated in Figure 12, the trend of Global Int.V was mostly similar with that of satisfaction of convenience from anywhere on campus, except the public green space-4, with a high Global Int.V of 3.75, but a relatively low convenience value of 1.18, whose ranking was respectively third and fourth position. Space-5 had the highest Global Int.V of 3.84 and highest convenience value from anywhere of 1.43. Correspondingly, space-1 had the lowest, scoring 3.46 and 1.01. Actually, the convenience from anywhere on campus means the whole campus accessibility. The higher convenience the whole campus has, the better accessibility the public green space has. Therefore, as the convenience of the campus space considered by the respondents was roughly the similar as the sorting of integration analyzed by Space syntax theory, the Space syntax theory of Hillier,(1997) works to a degree and in this case is similarly as revealing as we hoped it might be, especially in the ideal state not affected by such as traffic, road quality and so on (Hillier 1997).

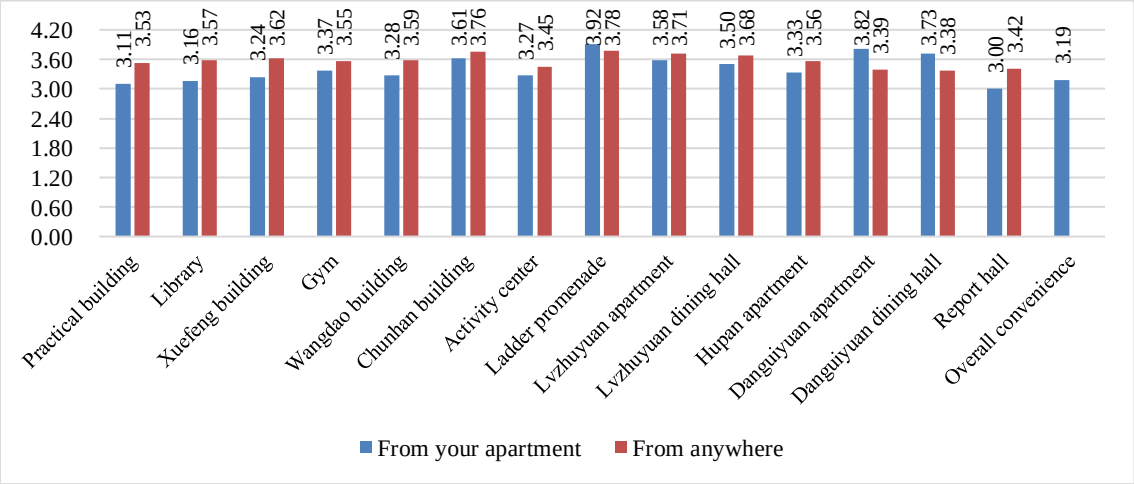

Figure 7.8 The perception of convenience to the six public spaces (from space-1 to 6).

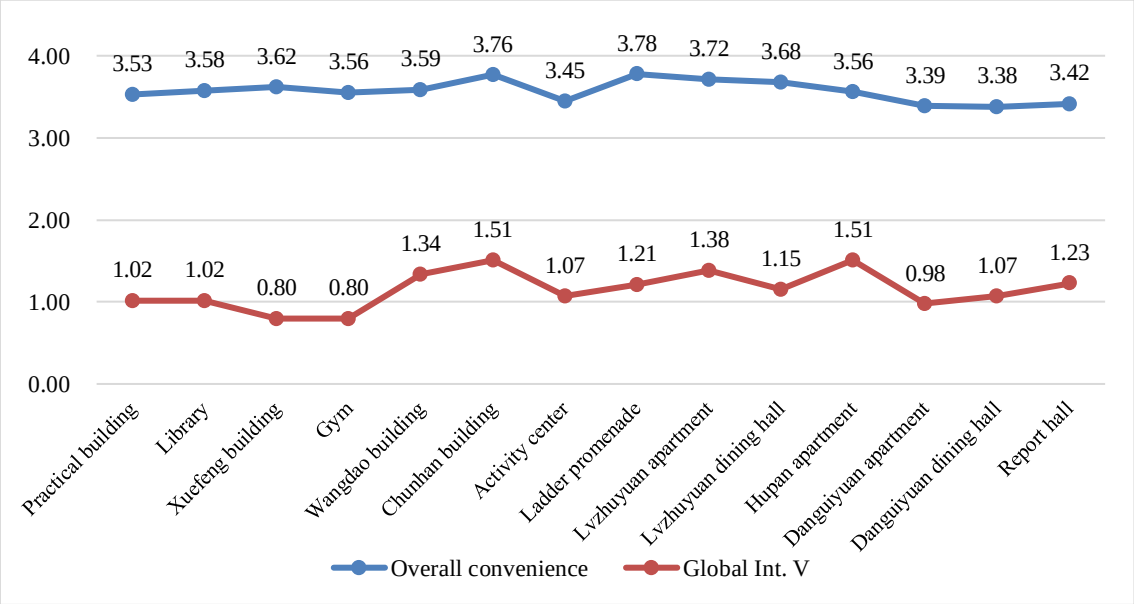

Figure 7.9 The relationship of Global Int.V of the main building spaces and students' perception of overall convenience on campus.

It can be seen from Figure 7.9 that the trend of the global integration value of the campus and the students' perception of the convenience of campus buildings are partly the same and partly different. Among them, Xuefeng building and Gym are low in global integration, but students consider it convenient. This may be caused by the sense of volume and function of the buildings. They are all very important buildings, and the daily usage rate of students is also high. Although Lvzhuyuan apartment and Hupan apartment perform very well in global integration, it is right on the side of Hangda road, but because the population used is specific (students living in Danguiyuan apartment will not pass by), the actual use situation affects Students' perception of its convenience within the whole school. It can be seen that the student's perception of the convenience of a certain building space is also affected by the frequency or familiarity with the buildings, which has been certified in section 7.3.2.

7.3.2. Impact of frequency of staying in buildings on the campus convenience

According to the question "Usually, how many days do you totally stay in those buildings during one week?", based on the frequency of staying in the 14 buildings (days per week) (n=1412), there are 5 choices given to respondents. The first choice, 1.0 means stays nearly no time in the building; 2.0 means stay 1 day in this building per week; 3.0 means 2 or 3 days; 4.0 means 4 or 5 days; 5.0 means 6 or 7 days in this building per week. The detail of staying in buildings can be seen in Table 6.11.

Table 7.2 is the ANOVA of the influence of days in Library to the respondents' perception of convenience on campus, which shows that if the days in Library will affect students' perception of convenience, including from apartment to the library, from anywhere on campus to the library and student's overall convenience perception.

Table 7.2 ANOVA of the influence of days in Library to the respondents' perception of convenience on campus.

ANOVA							
Convenience	Days in Library (Mean ±standard deviation)					F	p
	1.0(n=185)	2.0(n=427)	3.0(n=589)	4.0(n=138)	5.0(n=73)		
From apartment	2.86±1.51	3.06±1.38	3.25±1.37	3.41±1.35	3.55±1.47	5.78	0.000 **
From anywhere	3.28±1.35	3.50±1.17	3.64±1.15	3.76±1.12	3.92±1.26	6.154	0.000 **
Overall convenience	2.97±0.85	3.18±0.73	3.25±0.74	3.25±0.83	3.19±0.94	4.829	0.001 **
* p<0.05 ** p<0.01							

As shown in According to the question "Usually, how many days do you totally stay in those buildings during one week?", based on the frequency of staying in the 14 buildings (days per week) (n=1412), there are 5 choices given to respondents. The first choice, 1.0 means stays nearly no time in the building; 2.0 means stay 1 day in this building per week; 3.0 means 2 or 3 days; 4.0 means 4 or 5 days; 5.0 means 6 or 7 days in this building per week. The detail of staying in buildings can be seen in Table 6.11.

Table 7.2 is the ANOVA of the influence of days in Library to the respondents' perception of convenience on campus, which shows that if the days in Library will affect students' perception of convenience, including from apartment to the library, from anywhere on campus to the library and student's overall convenience perception.

Table 7.2: different days in library samples have significant significance for convenience from apartment, convenience from anywhere, and overall convenience ($p < 0.05$), which means that different days in library samples have convenience from apartment, convenience from anywhere. There are differences in overall convenience. Specific analysis shows:

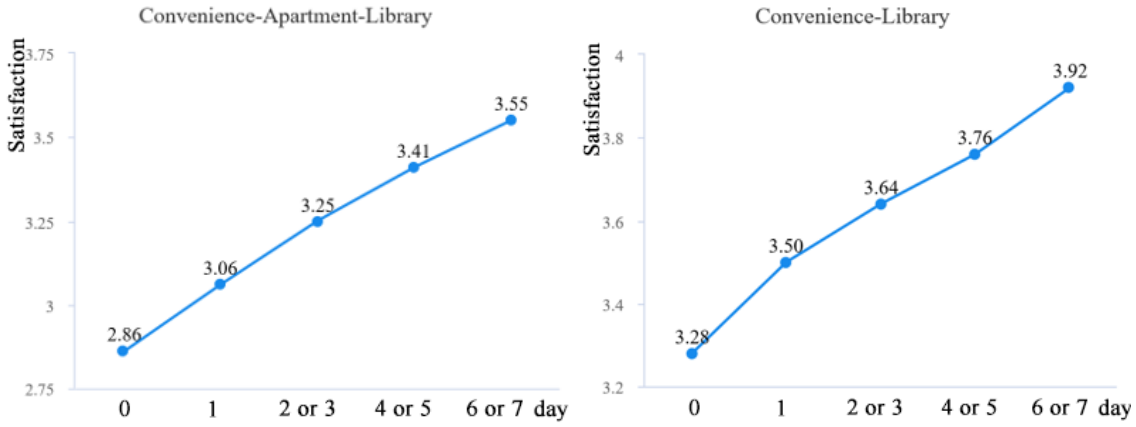

Figure 7.10 The influence of staying in Library to respondents' perception of convenience from their apartment and convenience from anywhere.

Days in library showed 0.01 level of significance for convenience from apartment and convenience from anywhere ($f = 5.780$, $p = 0.000$; $f = 6.154$, $p = 0.000$). From the line chart Figure 7.10, you can

see a significant trend line. Respondents who stayed at the library for 6 or 7 days a week thought that it was very convenient to go from the dormitory to the library, with satisfaction of 3.55, which was the highest. At the same time, the second most satisfied respondent stayed in the library for 4 or 5 days, only after 6 or 7 days. The same is true of the library's overall satisfaction. Respondents who stayed at the library for 6 or 7 days thought that the library was convenient throughout the school, with a satisfaction of 3.92. Whether it is the more convenient the dormitory to the library, or the more convenient the library is on the entire campus, the longer students stay in the library.

In summary, different days in library samples show significant differences for convenience from apartment, convenience from anywhere and overall convenience. In particular, the convenience from the dormitory to the library and the overall convenience of the library are significantly positively related to the utilization rate.

Table 7.3 ANOVA of the influence of days in Gym to the respondents' perception of convenience on campus.

ANOVA							
Convenience	Days Gym (Mean ±standard deviation)					F	p
	1.0(n=447)	2.0(n=441)	3.0(n=436)	4.0(n=51)	5.0(n=37)		
From apartment	3.13±1.29	3.35±1.24	3.54±1.25	3.86±1.11	3.86±1.16	9.342	0.000**
From anywhere	3.38±1.21	3.52±1.14	3.71±1.14	3.86±1.10	3.89±1.24	6.415	0.000**
* p<0.05 ** p<0.01							

Table 7.3 is the ANOVA of the influence of days in Gym to the respondents' perception of convenience on campus, which shows that the days in Gym will obviously affect students' perception of convenience, including from apartment to the library, and from anywhere on campus to the library ($p < 0.01$).

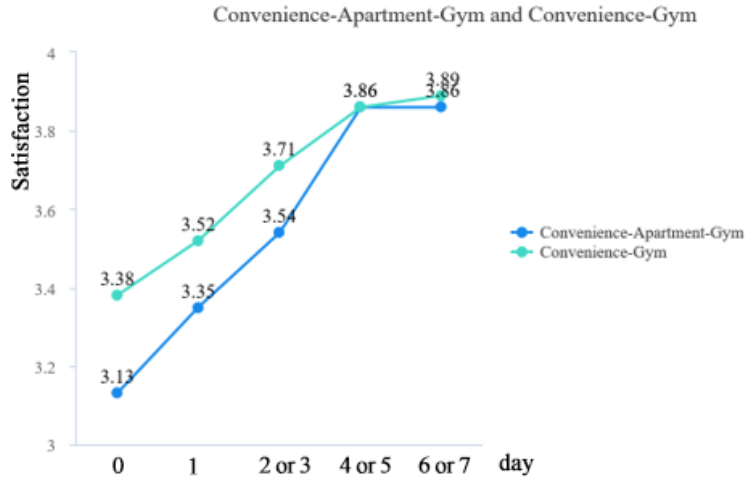

Figure 7.11 The influence of staying in Library to respondents' perception of convenience from their apartment and convenience from anywhere.

In summary, different Days in Gym samples show significant differences for Convenience from the

apartment to Gym and Convenience from anywhere to Gym. Like the convenience of the library and its utilization rate, the utilization rate of the gymnasium is also the same as the convenience of the dormitory to Gym or the global convenience of the Gym: the higher the convenience, the higher the utilization rate. The building convenience and utilization are completely positively correlated.

Chapter 8.
Conclusion and Recommendation

8.1. Summary of Research Study

8.1.1. Summary of each chapter

Chapter 1

This chapter describes in detail the development history of European and American universities and the development of modern universities in China. From the end of 20th century especially to 2008, the university campus expanded rapidly. Academician Jingtang He's team of South China University of Technology, who focus on Holistic, ecological, intensive and dynamic design presided over the new planning and design of more than 200 universities in China. After 2008, the rate of new university construction has slowed down. However, the campus space planning lacks post-occupancy evaluation (POE) and quantitative analysis. This research was conducted in this context. Taking two universities in Zhejiang as case study, 590 and 1412 questionnaires were collected.

Chapter 2

This chapter focuses on the theoretical research of campus planning and the development of post-occupancy evaluation systems. The research of university campus planning abroad is very extensive, including analysis of campus planning, summary of campus design, campus architecture and campus landscape design. Among them, the dynamic planning in America abandoned the previous fixed campus planning mode to have a complete master plan, including the overall form and architectural characteristics. China's university development, especially entering the 21st century, is also very extensive. The domains in post-occupancy evaluation (POE) was applied included housing, college dorms, mental health centers, and residential institutions with respect to environmental design, which is also applied in this research. At the same time, this chapter also reviews the campus greening, a part of urban greening but gained less attention.

Chapter 3

This study selected two university campuses in Zhejiang province for research. The first method is "field investigation", which observes and records the site characteristics. Secondly, qualitative and quantitative analysis is made based on the results of on-site observations, official data obtained by the school, and information obtained from the questionnaire. Thirdly, from September to November 2018, 590 questionnaires were successfully obtained on case-1 Yijin Campus, which including respondents' basic information, satisfaction with campus public green spaces, survey of students' demands and students' perception of convenience of campus. About case-2, from January to February 2018, 1412 questionnaires were obtained, which including respondents' basic information, satisfaction survey, students 'use of main building spaces and students' perception of convenience of campus. The fourth

is to use SPSS statistical method to conduct detailed and in-depth analysis of the questionnaire data. Among them, one-way ANOVA and correlation analysis are mainly used. Lastly, Space syntax theory is applied to the accessibility analysis of the campus, mainly to analyze theoretically whether the campus planning of the case is reasonable.

Chapter 4

This chapter analyzed the current situation of public green space in case-1, the analysis of the interviewees' situation, and the satisfaction, demand and usage condition of the public green spaces (but not positive). According to SPSS analysis, students' gender and their growth situation didn't affect their perception to the public green spaces, except male had a higher satisfaction of safety. However, the students frequently visiting the green spaces averagely had higher evaluations about the sampled green spaces than the students occasionally visiting the spaces. The proportion of students moving around on campus in the morning is very small and frequently in afternoon or after class around the teaching building and the library, so more rest facilities and better maintenance should be equipped with, such as galleries, benches and pavilions. Besides, female is rarely moving around in night but male prefers to. At the same time, there are some living facilities around the dormitory needed like drying racks, and simple exercise facilities like single parallel bars.

Chapter 5

The results of Space syntax analysis showed that some green spaces were located in well-integrated road networks. Those spaces assessed on the ground as being accessible, as indicated in our survey, were also in more highly integrated areas, especially in R3 and at the Rn level. From the feedback of the responds, it can be seen that those places such as the sampled green spaces of space-5 and 2 are considered to be more convenient also happen to be places with good accessibility. Conversely, the accessibility of inconvenient places like space-1 and 6, is correspondingly lower. Therefore, in the early stage of planning, the buildings and spaces should be reasonably laid out, so that the important and needed spaces can be arranged in a place with high accessibility.

Chapter 6

This chapter mainly analyzed the information of the main buildings and the respondents in case-2. An analysis about students' main activities on campus found that students from Danguiyuan apartment having more classes than those from other apartments, but were significantly choosing sleeping and online shopping, and choosing sports and other outdoor activities obviously less. Among them, female is more inclined to dining, surfing the Internet, shopping online, sleeping and having classes and studying, while male significantly prefers to part-time job online and outdoor sports. Freshman male students are much more satisfied with campus space size, facilities and the overall environment. In terms of the utilization of the main buildings on the campus, male goes to Gym and Activity centers very significantly often and the more people who go to Gym and activity centers, the easier it is to give extreme points, such as 1 and 5 points. However, those who do not go often will give some

intermediate points. Students in different dormitories have very obvious differences in choosing activities after meals. The proportion of respondents living in Danguiyuan apartment chose “direct back to your dormitory to rest and play”, and “buying snacks in the school supermarket, cake shop of fruit shop” much more. Similarly, it is very obvious that the first choice for respondents to choosing exercising place is “near my apartment”. From this survey, we can see that the dormitory position plays a huge role in the selection of activities for students.

Chapter 7

According to Space syntax theory and the global integration value calculated by the DepthMap software, the accessibility, Road-1, Road-2, Road-3 and Road-4 are the most accessible places on the campus, which are the same as the actual situation. Road-1 was the earliest road in the early construction of the school, and the rest of the functions were extended from this road. This fully demonstrates that space syntax is feasible in campus planning, and its calculated accessibility is in line with the actual degree of campus access. Different days in library samples show significant differences for convenience from apartment, convenience from anywhere and overall convenience. The better the convenience, the higher the usage rate. So is the use of Gym.

Chapter 8

This chapter summarizes the conclusions of the above 7 chapters. Based on the data and analysis results obtained in this study, the campus space layout of case-2 is optimized and re-calculated by Space syntax to ensure the accessibility and utilization can be improved in theory. At the same time, this chapter also gives some suggestions for the planning and design of new campus in the future.

8.1.2. Research of public green spaces on campus

This survey, investigating students' perceptions toward campus green spaces and further studying the accessibility and attractiveness of campus green spaces. In specific, in the context of a university in Hangzhou, the capital city of Zhejiang Province, China, through field observations, questionnaires, and accessibility analysis, we have revealed the usage condition of campus green spaces, students' perceptions, and factors affecting their satisfaction. On the premise of no existence of public green parks around Yijin campus, a large number of the respondents rarely visited the campus, and the usage was not positive. Besides, according to this research, students' gender and their growth situation (growing up in rural areas, small towns, urban areas or suburbs) didn’t affect their perception to the public green spaces on campus, which may also reflect that, benefited from the continuous development of urbanization, the students' cogitation and experience are constantly expanding, whose differences are certainly and naturally getting smaller and smaller. However, the frequency of visiting the campus played a role, that is, the students frequently visiting the green spaces averagely had higher evaluations about the sampled green spaces than the students occasionally visiting the spaces. Thus, the campus with a good green space quality, should promote the students to walk out of their dormitories and contact with the green environment, deepen their understanding about the campus.

A better evaluation about the campus green space and its maximum usage value can be obtained. Although the questionnaire was conducted in autumn (from September to November), indicating more negative growth of plants than that in spring or summer, affected students' perception about campus green spaces and possibly lower satisfaction, and the sample number or student distribution was not widely enough, this research still has certain representative meaning, which can reflect the students' perception about campus green spaces in ordinary colleges and universities. Regarding the factors affecting usage of campus green space, we have investigated and obtained the following reasons.

（1） Lack of time to go out of dormitories

According to a survey conducted by Capital Medical University, 77% of the students surveyed, except having class and some activities must being participated in, rarely took the initiative to join in social life, and preferred to spend most time in their dormitories (Tang 2016). From this survey, it can be indicated that the afternoon and after class are the frequently visited time period, and relatively, the proportion of students moving around on campus in the morning is very small, which naturally will make less use of public facilities including campus greening, in addition to the negative impact on students mentally and physically. As Kaplan and Kaplan (1989) showed, the negative impacts of stressful life events may easily attack individuals living in areas lacking green space, because they have fewer opportunities in touch with nature-based coping strategies than who can exposure to abundant green space (Kaplan and Kaplan 1989). Therefore, it has been a serious issue to improve the utilization of campus green space and prompt students to actively participate in social interaction and green spaces.

（2） Poor attractiveness of green spaces

The quality of the green space itself, such as the collocation about the species or layers of plants, the seasonal color richness and so on, can reflect the attractiveness of green spaces and affect the satisfaction of students. However, the plant configuration of the campus green space is easy to be monotonous like space-1 and 6: the combination of tall trees, medium-sized shrubs and herbaceous plants, so is the flowering period: concentration in spring and summer, resulting into a low satisfaction. A reasonable plant configuration, in order to develop a corresponding seasonal color richness and high-quality landscape, is a way to improve the attractiveness of the green space itself.

（3） Shortage of green space facilities and neglected maintenance

According to this survey, students preferred to visit the green space during the period after the class and afternoon, and around the teaching building and the library, so more rest facilities should be equipped with, such as galleries, benches and pavilions. At the same time, there are some living facilities around the dormitory needed like drying racks, and simple exercise facilities like single parallel bars. Through improving the functions of the green space, the attraction of green spaces to

students will be increased, making students more motivated to get out of dormitories, which will not only conduce the utilization of campus green space, but also contribute to the chances of students getting close to nature. Meanwhile, good facilities maintenance is also conducive to better use of green space. In Yijin campus, space-2 was relatively high-quality compared to other green spaces, which owned plenty of benches and a gallery with entwining vines, but the benches under the gallery or trees were covered with moss, and many green plants were so dense as to difficultly enter. As a result, the satisfaction of space-2 was not much higher than other sampled green spaces.

（4） Low accessibility of green spaces

The results of the space syntax analysis proved to be interesting and showed that some green spaces were located in well-integrated road networks. Those spaces assessed on the ground as being accessible, as indicated in our survey, were also in more highly integrated areas, especially in R3 and at the Rn level. From the feedback of the responds, it can be seen that those places such as the sampled green spaces of space-5 and 2 are considered to be more convenient also happen to be places with good accessibility. Conversely, the accessibility of inconvenient places like space-1 and 6, is correspondingly lower.

Therefore, in the early stage of planning, the buildings and spaces should be reasonably laid out, so that the important and needed spaces can be arranged in a place with high accessibility, and the convenient access of students can be improved as much as possible. In addition, we should also pay attention to those spaces with low accessibility. Because these spaces have insufficient control over the surroundings, students may feel inconvenient and rarely walk forward, which is likely to cause a remote corner of the campus. Therefore, these places require enough daily maintenance and security patrols, otherwise it will easily have a negative impact on campus security.

8.1.3. Research of main building spaces on campus

How to do campus planning? Whether it is in developed countries or in China, there are many practical cases of campus planning. Especially in China, the new construction of colleges and universities has expanded rapidly since the 20th century, and the design cycle is relatively short. Designers tend to design a vivid picture of the master plan from the aesthetics of the drawings. The functional layout of the design also has a great commonality, and even replicates other projects: there is usually a lake or a large lawn on the campus, surrounded by teaching buildings or a library. Teaching areas, office areas and living areas are often separated very clearly. But is the utilization rate of campus building space in this form high? Are students satisfied with this? Students and teachers are the real users of campus space, whose needs should be the basis of architectural design, which, however, campus planners pay little attention on.

Therefore, this part of the survey, starting from a practical case, based on the post-occupancy evaluation, research how to improve the attractivity and accessibility of campus main building spaces

for developing a sustainable university environment.

（1） Satisfaction with campus space size

The YWICC campus has a total area of 35.59 ha (excluding the area of Jimingshan Park) and a per capita campus area of 37.07 ㎡. However, 18% of respondents feel unsatisfied or very dissatisfied.

In terms of gender satisfaction with the overall spatial scale of the campus, it can be seen from the figure that male respondents, 26.52% and 3.58% respectively chose satisfaction and very satisfied, higher than female's 25.53% and 1.52%. However, 15.77% and 4.66% of men chose to be dissatisfied and very dissatisfied.

In terms of grade satisfaction with the overall size of the campus, Grade 1 students are very satisfied with the campus, 29.14%, significantly more than 22.75% of Grade 2, and 18.50% more than the third grade. Dissatisfaction is also significantly less than Grade 2 and Grade 3. Therefore, from the survey, the lower the grade, especially the male students in the lower grades, the higher the satisfaction with the overall space of the campus.

（2） Satisfaction with campus facilities and environment

As for the satisfaction with campus facilities, male students were satisfied (37.99%) and very satisfied (3.76%), a total of 41.75%, which was also significantly higher than females (30.09% and 1.29% respectively, total 31.38%). At the same time, the number of females feeling fairly satisfied is significantly higher than that of males. As far the satisfaction with campus facilities, the proportion of Grade 1, is also significantly higher than Grade 2 and Grade 3.

In terms of satisfaction with the overall environment of the campus, the proportions of male respondents feeling “satisfied” and “very satisfied” were 48.39% and 6.99% respectively, 55.38% totally, significantly higher than female's 42.15% and 2.22%.

The difference in grades also has an impact on the overall environmental satisfaction of the campus. The proportion of respondents of Grade 1 feeling “satisfied” and “very satisfied” were 45.44% and 4.32% respectively, a total of 49.76%, similarly higher than Grade 2 and Grade 3.

（3） Usage condition of the library and exercising places

The frequency of students living in Lvzhuyuan apartments are much higher than students in Danguiyuan apartment. The accessibility of Lvzhuyuan apartment are better than Lvzhuyuan apartment and much closer to the library.

Additionally, it is very obvious that the first choice for respondents to choosing exercising place is “near my apartment”, with 1140, 80.74% choosing this reason.

（4） Habitual behavior after the meal in canteen

The proportion of students in Danguiyuan apartment who chose these two items were 42.69% and

26.24%, were significantly higher than those of Lvzhuyuan and Hupan apartment. And the proportion of males, 42.39% and 26.81%, were higher than women's 37.10% and 24.01 %.

From this we can see how high the dependence of contemporary college students on the dormitory, and surely, the location and accessibility of the dormitory in the campus planning is very important.

（5） The accessibiliy of campus spaces

According to Space syntax theory and the global integration value calculated by the DepthMap software, the accessibility, Road-1, Road-2, Road-3 and Road-4 are the most accessible places on the campus, which are the same as the actual situation. Road-1 was the earliest road in the early construction of the school, and the rest of the functions were extended from this road. This fully demonstrates that space syntax is feasible in campus planning, and its calculated accessibility is in line with the actual degree of campus access.

The degree of integration is highly correlated with the distribution and displacement of human flow in space. In most cases of syntactic, where the integration is high, the space often has higher spatial accessibility and attracts more people and traffic.

8.2. Recommendation

The aim of this research was to obtain an overview of the current usage of green spaces on campus in general and Yijin campus in detail at the scale of the entire campus, and to examine their degree of accessibility, the usage characteristics and factors affecting utilization for the better campus planning. The current campus green space usage condition is not positive, especially in the morning, fewer students visiting green spaces. Besides, male students choose after class and in evening to moving around on campus, however, female students prefer to after class and afternoon instead of evening considering safety. However, the differences in gender and growth situation (rural area, small town, urban area and urban suburb) have little difference in perception of green space, but the familiarity with the campus works. Therefore, at the very beginning, in the overall campus planning stage, based on the analysis of Space syntax theory, large-scale and important public green spaces should be set up in places with high accessibility, and be carefully designed, making it a true central point. High-quality of green space plants, including plant configuration and seasonal color richness, and rational settings of greening facilities based on the different needs of students should be fully implemented. Furthermore, strengthening the maintenance and management of campus green space is equally essential. After these measures, the attractiveness and accessibility of campus green spaces will be greatly enhanced, a relatively positive utilization condition followed naturally, which will promote a sustainable development of green campus and an obtainment of long-term ecological, social and economic benefits of green spaces.

In contemporary campuses, college students' dormitories play a very important role. Therefore, during the campus planning, the dormitory can be placed in a more accessible place, closely connected with

libraries and exercise places, instead of placing the dormitory on corner of campus. This innovative plan is actually more in line with the needs of students, helping to increase the attractiveness of the campus and the utilization of public building space.

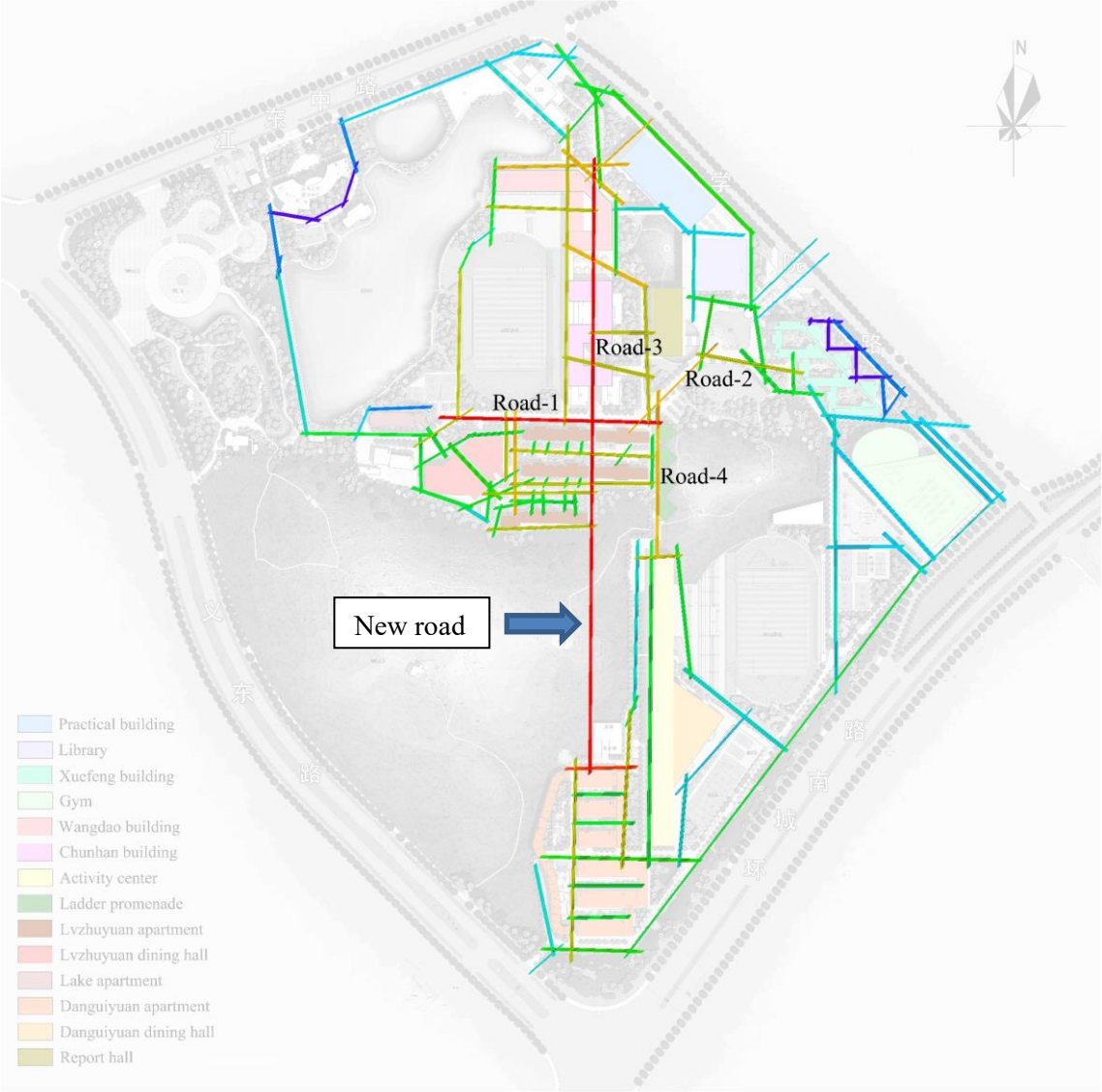

Figure 8.1 Analysis by DepthMap based on Space syntax theory according to the optimized campus planning of YWICC

Table 8.1 Comparison of Global Int. V before optimization and after optimization (a new road is added).

	Road-1	Road-2	Road-3	Road-4
Before optimization	1.526	1.307	1.366	1.362
After optimization	1.651	1.443	1.725	1.384

Assuming that the topographic influence of the original site is not considered, a road that runs through Chunhan building and Lvzhuyuan apartment and reaching Danguiyuan building is designed on the current campus planning calculated based on Space syntax theory. After using DepthMap software to

recalculate the global integration value, the results are shown in the figure. The campus area with the highest accessibility has changed from the intersection of Road-1 and Road-2 before optimization to the intersection of Road-1 and Road-3, but the four roads with higher global accessibility are still relatively concentrated. The global integration value of Road-1 will increase from 1.526 before optimization to 1.651 after optimization. Road-2 will increase from 1.307 to 1.443. Road-3 will increase from 1.366 to 1.725, becoming the route with the highest global integration of the entire campus. Road-4 will increase from 1.362 to 1.384. The accessibility of the entire campus has improved significantly, especially Danguiyuan apartment, where the students living will have easier access to all areas of the campus. According to the analysis, improved accessibility will help students to use more frequently the library or activity center, etc.

Figure 8.2 The campus planning with suggested main building functions

According to a lot of analysis, Space syntax theory can represent the accessibility of campus space to a certain extent. The higher the accessibility, the more convenient the students feel, and the utilization rate of the building will be relatively improved. Therefore, campus planners should calculate and verify the global integration value based on Space syntax from the beginning to analyze the designed road network. Areas with the highest accessibility should include the most important buildings on campus, such as the library and student activity center. The teaching building is a place that students must go because of the arrangement of the courses. Therefore, we suggest that the areas with the highest accessibility on campus can be designed as the library, activity centers, and gyms, which in theory, will increase the utilization of these buildings. The increase in the utilization rate of such buildings is conducive to the overall development of students and the construction of green campuses, and also to the improvement of students' satisfaction on the campus.

8.3. Further Research

（1） The use of Space syntax and future research directions

The Space syntax evaluation method is also not perfect, and its theoretical and methodological aspects do not take into account the quality (attractiveness) of service facilities. In fact, spatial accessibility is

a very broad concept that is related to many subjective and objective factors. This paper is only a methodological attempt to explore the accessibility of campus spaces in different levels based on Space syntax. In the future, it is necessary to strengthen the research on the behavioral preference of campus spaces and its spatial accessibility. Campus spaces accessibility provides a more solid research foundation. How to further accurately assess the accessibility and service status of campus space systems, explore its influencing factors and optimize the spatial layout need further research.

（2） Adequate case study

In addition, the cases selected in this paper are very limited in terms of quantity and geography. To obtain a universally applicable theorem, more comprehensive cases need to be applied. This will be the next step we need to study.

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Appendix

Questionnaire Survey

Dear respondent, this questionnaire is designed solely to carry out the investigation of green spaces on Yijin Campus of Zhejiang A & F University. Your prompt cooperation in responding to the questions appropriately shall be highly appreciated. All information provided will be treated with strict confidentiality. Thank you!

Dear respondent, this questionnaire is designed solely to carry out the investigation of green spaces on Yijin Campus of Zhejiang A & F University. Your prompt cooperation in responding to the questions appropriately shall be highly appreciated. All information provided will be treated with strict confidentiality. Thank you!

Part A: Personal Information

1. Gender:

☐Male ☐Female

2. Your growth situation:

☐Rural area ☐Small town ☐Urban area ☐Urban suburb

3. Your grade:

☐Grade one ☐Grade two ☐Grade three ☐Grade four ☐Master

4. Your faculty:

☐Faculty of Economics and Management ☐Faculty of Culture and Law ☐Faculty of Continuous Education

5. Where do you currently reside now?

☐E7 ☐E8 ☐E9 ☐E10 ☐Lianjian apartment ☐Off campus

6. How much time averagely in each day you will take a walk around on campus, excluding the time spent indoors, but including the time spent on the way to classroom or otherwhere?

☐Nearly no (0-10 mins) (Please ignore question 9) ☐Sometimes (10-30 mins) ☐Often (>30 mins)

The positions of six green spaces are shown in the map.

Part B: The perceptions about six green spaces

7. Do you think the quality of these 5 public green spaces make you satisfy? Plant collocation means the cooperation of plants type and shape, and the multiple diversities. Seasonal color richness means if the color of public green space can change with the seasons. Besides, usually the plant can be regularly trimmed. Please encircle the number which is most appropriate to your level of agreement/satisfaction. “1” means very dissatisfied, “2” dissatisfied, “3” fairly satisfied, “4” satisfied, “5” very satisfied.

Spaces	Plant collocation					Color richness					Settings for rest					safety					Overall				
1	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

8. What do you want the following green spaces to meet your needs? The facilities mean the common use of equipment, exercise facilities like single-parallel bars, and living facilities like drying racks. Please click the one you need in each space (multiple answers).

Spaces	Reading or resting	Enjoying scenery	Chatting or walking	Exercise facilities	Living facilities	Others
1						

2						
3						
4						
5						
6						

9. When do you use each of these 6 public green spaces (multiple answers)?

Spaces	Morning	Afternoon	Evening	Before class	After class	Others
1						
2						
3						
4						
5						
6						

10. Do you think it is convenient from the main campus gate, from your dormitory or from anywhere of the campus to each of these public spaces? Please choose how satisfied you are.

Spaces	From the main campus gate					From your dormitory					From anywhere of the campus				
1	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
2	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
3	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
4	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
6	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

Thank you for completing this survey!

Questionnaire Survey

Dear respondent, this questionnaire is designed solely to carry out investigation on the topic of "Analysis of the morphology and accessibility character to optimize the planning of vocational college" for a Ph D Research in Architecture, the University of Kitakyushu, Japan. Your prompt cooperation in responding to the questions appropriately shall be highly appreciated. All information provided will be treated with strict confidentiality.

Thank you.

Part 1: Personal Information

1. Gender:

□Male ☐Female

2. Your student number and name (Only for the investigation of the school situation and no any influences):

□Student number _____ □Name _____

3. Your grade:

□Grade one

□Grade two

□Grade three

□Others

4. Which college do you belong to?

_____

5. Where do you currently reside?

□Danguiyuan apartment □Lvzhuyuan apartment □Hupan apartment

□Off-campus housing □Other: (Please specify) _____

6. Have you had parttime job since you entered this university?

□Yes, I have. □No, I don't have.

7. If you have, where is your work place? (If you don't have, please skip)

□On-campus □Off-campus □Both

8. Usually, how many percent of one week do you stay in the campus?

□0-20% □20%-40% □40%-60% □60%-80% □80%-100%

9. What are your main activities when you stay in the campus?(You can choose 4 answers)

□sleeping □having classes and studying □playing games □dining □chatting and collective activities □surfing on the Internet □Shopping on the Internet □Part-time jobs online □sports and other outdoor activities □Other: (Please specify) _____

There are 14 main functional buildings in the campus. They are Practical building, Library, Xuefeng building, Gym, Wangdao building, Chunhan building, Activity center, Ladder promenade, Lvzhuyuan apartment, Lvzhuyuan dining hall, Hupan apartment, Danguiyuan apartment, Danguiyuan dining hall, Report hall.

Please encircle the number which is most appropriate to your level of agreement/satisfaction. "1" means very dissatisfied. "2" means dissatisfied. "3" means fairly satisfied. "4" means satisfied. "5" means very satisfied.

Part 2: The space and indoor facilities condition in the campus

10. Do you think the size of spaces of the 14 buildings is big enough and satisfy you?

Buildings/ topics	Size of spaces				
Practical building	1	2	3	4	5
Library	1	2	3	4	5
Xuefeng building	1	2	3	4	5
Gym	1	2	3	4	5

Wangdao building	1	2	3	4	5
Chunhan building	1	2	3	4	5
Activity center	1	2	3	4	5
Ladder promenade	1	2	3	4	5
Lvzhuyuan apartment	1	2	3	4	5
Lvzhuyuan dining hall	1	2	3	4	5
Hupan apartment	1	2	3	4	5
Danguiyuan apartment	1	2	3	4	5
Danguiyuan dining hall	1	2	3	4	5
Report hall	1	2	3	4	5

11. Are you satisfied with the size of school space in the overall campus?

□very dissatisfied □dissatisfied □fairly satisfied □satisfied □very satisfied

12. What do you think about the facilities and equipment in those 14 buildings? For examples, the operation machines in Practical building, the books and public computers in Library, and so on.

Buildings/ topics	Indoor facilities &equipment				
Practical building	1	2	3	4	5
Library	1	2	3	4	5
Xuefeng building	1	2	3	4	5
Gym	1	2	3	4	5
Wangdao building	1	2	3	4	5
Chunhan building	1	2	3	4	5
Activity center	1	2	3	4	5
Ladder promenade	1	2	3	4	5
Lvzhuyuan apartment	1	2	3	4	5
Lvzhuyuan dining hall	1	2	3	4	5
Hupan apartment	1	2	3	4	5
Danguiyuan apartment	1	2	3	4	5
Danguiyuan dining hall	1	2	3	4	5
Report hall	1	2	3	4	5

13. Are you satisfied with the facilities in the overall campus?

□very dissatisfied □dissatisfied □fairly satisfied □satisfied □very satisfied

Part 3: The environment and entrance of the buildings in the campus

14. Are you satisfied with the environment including the interior cleanliness, and surroundings' green spaces of those 14 buildings?

Buildings/ topics	Interior cleanliness					Surroundings' green				
Practical building	1	2	3	4	5	1	2	3	4	5
Library	1	2	3	4	5	1	2	3	4	5
Xuefeng building	1	2	3	4	5	1	2	3	4	5
Gym	1	2	3	4	5	1	2	3	4	5
Wangdao building	1	2	3	4	5	1	2	3	4	5
Chunhan building	1	2	3	4	5	1	2	3	4	5
Activity center	1	2	3	4	5	1	2	3	4	5
Ladder promenade	1	2	3	4	5	1	2	3	4	5
Lvzhuyuan apartment	1	2	3	4	5	1	2	3	4	5

Lvzhuyuan dining hall	1	2	3	4	5	1	2	3	4	5
Hupan apartment	1	2	3	4	5	1	2	3	4	5
Danguiyuan apartment	1	2	3	4	5	1	2	3	4	5
Danguiyuan dining hall	1	2	3	4	5	1	2	3	4	5
Report hall	1	2	3	4	5	1	2	3	4	5

15. Are you satisfied with the environments in the overall campus?

□very dissatisfied □dissatisfied □fairly satisfied □satisfied □very satisfied

16. Do you think it obvious of the following buildings' entrance?

Buildings/ topics	Obvious entrance				
Practical building	1	2	3	4	5
Library	1	2	3	4	5
Xuefeng building	1	2	3	4	5
Gym	1	2	3	4	5
Wangdao building	1	2	3	4	5
Chunhan building	1	2	3	4	5
Activity center	1	2	3	4	5
Ladder promenade	1	2	3	4	5
Lvzhuyuan apartment	1	2	3	4	5
Lvzhuyuan dining hall	1	2	3	4	5
Hupan apartment	1	2	3	4	5
Danguiyuan apartment	1	2	3	4	5
Danguiyuan dining hall	1	2	3	4	5
Report hall	1	2	3	4	5

Part 4: The usage conditions of the campus

17. Usually, how many days do you totally stay in those buildings during one week? Please encircle the blank which is the most appropriate description of your time in these buildings.

Buildings/ days	0	1 day	2 or 3 days	4 or 5 days	6 or 7 days
Practical building					
Library					
Xuefeng building					
Gym					
Wangdao building					
Chunhan building					
Activity center					
Ladder promenade					
Lvzhuyuan apartment					
Lvzhuyuan dining hall					
Hupan apartment					
Danguiyuan apartment					
Danguiyuan dining hall					
Report hall					

18. Where do you do exercise more often?
□Lake playground □Mountain playground □Gym on-campus □Gym off-campus and others
19. Why do you prefer to go to this place? (You can choose 4 of them)
□near to my apartment □near to the classrooms □a better environment □ a new space
□better facilities □my friends' choice □Other: (Please specify) _____
20. On average how many days per week will you go to this place?
□1 or less days □2 days □3 days □4 days □5 days □6 days □everyday
21. After the meal in canteen, what will you generally choose to do?
□walking around the campus □walking and rest in the playground and grass □buying snacks in the school supermarket, cake shop or fruit shop □direct back to your dormitory to rest and play □activities in Student union or community □activities off the campus □others

Part 5: The accessibility condition of the campus

Accessibility means how conveniently this building connects with other buildings or with its surroundings.

22. Do you think those 14 buildings convenient to reach this building from your apartment, and any other buildings connect with these buildings?

Buildings/ topics	Convenience to reach it from your apartment					The connection with other buildings				
Practical building	1	2	3	4	5	1	2	3	4	5
Library	1	2	3	4	5	1	2	3	4	5
Xuefeng building	1	2	3	4	5	1	2	3	4	5
Gym	1	2	3	4	5	1	2	3	4	5
Wangdao building	1	2	3	4	5	1	2	3	4	5
Chunhan building	1	2	3	4	5	1	2	3	4	5
Activity center	1	2	3	4	5	1	2	3	4	5
Ladder promenade	1	2	3	4	5	1	2	3	4	5
Lvzhuyuan apartment	1	2	3	4	5	1	2	3	4	5
Lvzhuyuan dining hall	1	2	3	4	5	1	2	3	4	5
Hupan apartment	1	2	3	4	5	1	2	3	4	5
Danguiyuan apartment	1	2	3	4	5	1	2	3	4	5
Danguiyuan dining hall	1	2	3	4	5	1	2	3	4	5
Report hall	1	2	3	4	5	1	2	3	4	5

23. Are you satisfied with the convenience in the overall campus?
□very dissatisfied □dissatisfied □fairly satisfied □satisfied □very satisfied
24. What kind of tools will you mainly move by in the overall campus?
□by bike □on foot □by skateboard □by electric vehicle □Other: (Please specify) _____

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