




## Article

# Suitability Evaluation of Popular Science Tourism Sites in University Towns: Case Study of Guangzhou University Town

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**Abstract:** With the advent of the knowledge economy, universities have increasingly important roles in cities. However, some universities and cities are still fragmented, and popular science tourism is one way to solve this. The purposes and destinations of popular science tourism differ from those of traditional tourism. Consequently, their resources have a high development value for ecological and human resources. However, research on popular science tourism in China is still in its infancy. Here, we studied popular science tourism from a geographical perspective, selecting scale capacity, environmental level, resource level, location, and service conditions as factors to construct a judgment matrix to calculate the weights of indicators at various levels. Analytic hierarchy was used to build a popular science tourism evaluation system for Guangzhou University Town as a case study and the suitability of each tourist destination in the university town was evaluated. The results show that west Guangzhou University Town is more suitable for popular science tourism than the east, which possesses more value for popular science tourism development. Finally, we give recommendations for developing popular science tourism in Guangzhou University Town.

**Keywords:** unconventional tourism; popular science tourism resources; development suitability; evaluation system; geographic information system; Guangzhou University Town



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## 1. Introduction

### 1.1. The Development of Science Tourism and the Role of Universities

With the improvement of education and the cultural level of tourists, traditional sightseeing tourism can no longer meet the personalized and diversified needs of tourists; thus, science tourism, which is a knowledgeable, educational, engaging, and entertaining form of tourism, has emerged to supplement traditional tourism. Traditionally, schools and universities are places where people learn and conduct research [1,2]; however, few consider them to be potential tourist destinations. In spite of this, popular science tourism has emerged with the purpose to gain knowledge and learn more about emerging technologies, rather than entertaining and relaxing; this is also known as “spiritual fulfilling tourism” [3]. Universities are at the forefront of scientific development and can fulfill people’s needs; however, universities often do not provide accommodation outside the university grounds. If universities can work with residents of the surrounding area, then university towns can become a new kind of fully serviced tourist destination and become unique growth points for the tourism industry.

In 2015, China set out development goals for the next five years of building a moderately prosperous society, becoming an innovative country, and becoming a world power in science and technology. For these goals, the popularization of science is a key aspect and has great social significance. The “13th Five-Year Plan for Building a National Science Popularization and Innovation Culture” (from here on referred to as “the Plan”), formulated by the Ministry of Science and Technology and the Central Propaganda Department

as part of the “Outline of the National Strategy for Innovation-driven Development” and the “13th Five-Year Plan for National Science and Technology Innovation” emphasizes the importance of the popularization of science. The Plan states that science popularization can enhance the level of social civilization, improve the quality of the ecological environment, promote the spirit of science and popularizing scientific knowledge in society as a whole, raise awareness of science and technology and scientific quality, and improve the ability of the population to solve practical problems and participate in public affairs.

Some scholars have defined science tourism resources to be the key to science tourism [4–6], believing that science tourism resources are “the sum of various natural and social factors that occupy a certain geographical space in nature and human society, and have special scientific and cultural values, and can be attractive to tourists, and can be exploited by the tourism industry, and produce scientific and cultural dissemination effects.” Scholars have provided suggestions for the development of science tourism in specific cities, considering the science tourism resources in the area [7–9]. Science tourism industry projects started earlier and have achieved more than universities. Industrial science tourism is the most successful form of science tourism, mainly involving automobile manufacturing enterprises, such as Hyundai in South Korea, Toyota in Japan, Renault in France, and Volkswagen in Germany. However, with the rapid changes in science and technology, science tourism is gradually moving toward cutting high technology. The high-tech café project is a current research hotspot and universities are the best carriers for it [10]. In recent years, with the advent of the knowledge economy, universities have taken on additional functions and responsibilities, such as being sustainable parts of the city’s futures, cultural icons and symbols, hearts of urban innovation, and suitable places for employment [11]. Therefore, campuses now emphasize the links among creativity, higher education, and urban life. These physical and functional links with the wider community and urban fabric can help improve the competitiveness, productivity, and cultural strength of a city [12,13] and should be considered before a university or university town is built. Some cities and their universities provide us with good examples, as shown in Table 1.

In general, as well as playing roles in teaching students, universities are important for the development of their respective cities. From the above analysis of the relationship between renowned universities and cities, it can be concluded that the beneficial relationship between cities and universities is mutual [21]. The knowledge economy has had the effect of breaking down traditional boundaries between campus and city. Modern universities are the most fertile intellectual environments and are no longer specialized cells; they are becoming accessible, giving ordinary people access to the most cutting-edge knowledge and technology [22]. In China, universities are still in their early stages of development, with campuses cut off from their cities and are gradually facing the challenge of transformation. One way to help integrate the campus and the city is through science tourism.

For the development of science tourism in China, most scholars in recent years have focused on the existing natural resources in their study areas, such as wetlands and parks, and designed science tourism routes based on these [23–26], while ignoring the role that universities could play in science tourism.

As pioneers of academic science and technology research, university towns are the birthplace of many recent scientific and technological achievements. For example, a university in a university town in Guangdong Province demonstrated the latest technology in pollution control to the public based on its own environmental technology innovation platform [27]. As a result, compared to conventional tourism, science tourism is more focused on the dissemination of knowledge and technology and often offers a more in-depth experience. Moreover, some research show that due to COVID-19, people are now more likely to choose short trips, while focusing more on destinations that are more than just leisure [28,29]. As a result, popular science tourism, especially in a university town that is close to the center of the city, becomes a good choice for most people. Travel companies and universities can design travel products based on various technologies already available,

such as tracking through personal registration information, government, or analysis based on reviews of travel software [30–32].

**Table 1.** Some famous universities and their role and functions in cities.

University	City	Roles and Functions
Chicago University, Northwest University, and University of Illinois at Chicago	Chicago, United States of America	A leisure center for the city’s inhabitants, a central place for the development of the city’s scientific and technological strength, an important cultural center and tourist destination for the city. Creates many jobs and contributes to the economic development of Chicago [14,15].
Cambridge University	Cambridge, United Kingdom	A model of city–university integration, the University of Cambridge has broken down the traditional boundaries between campus and city in its construction. The city provides the environment for the university to develop, and the university provides the city with a humanistic foundation and heritage, enhancing its potential for development. In the current and future plans, the University of Cambridge serves as part of the heart of the city, providing services and leisure to the surrounding community, while also using advanced technology to replicate the traditional Cambridge scene, allowing more people to choose Cambridge or Cambridge University as a travel destination [16].
University of Technology Sydney	Sydney, Australia	Located in the heart of Sydney, it has a complete infrastructure and is designed without clear boundaries with the surrounding neighborhoods (i.e., no fences). Therefore, the school provides a recreational space for the surrounding neighborhoods and allows for the initial practice and popularization of advanced technologies, which can be combined with practical technological improvements while promoting them. In addition, the school improves the sophistication of urban governance through alliances with planning and municipal authorities, while also repositioning the city to external investors and knowledge workers [17].
Arizona State University	The city of Phoenix, United States of America	The university is an important part of the development of the City of Phoenix, providing jobs, the latest technology, and training for the city’s workforce, as well as providing the nearby community with a recreational area of shopping, dining, and other functions. In turn, the city provides funding, space, and policies to support the university’s development [18].
Hönggerberg site of ETH Zürich	Zürich, Switzerland	The transformation from a traditional campus to a community center is a typical example of campus-led regional development. The campus is surrounded by a high density of housing and shops, providing a recreational space for the surrounding population (e.g., Leerpark Dordrecht, West) and promoting high-tech experimentation [19].
Washington University	Seattle, United States of America	The University of Washington has strong ties to the surrounding community and downtown. It is also a center for weekend recreation for city residents. As part of the urban landscape, the University of Washington provides residents with a place to relax and promotes all aspects of the campus and gives citizens a taste of the latest technology [20].

University towns have considerable potential as foundations for science tourism. Guangzhou, an innovative city in the southern coastal region of China, is equipped with many excellent educational resources at all levels, from primary schools to universities, owing to its advanced level of economic and social development. However, these resources are in urgent need of development and are expected to be planned based on local realities [33]. In addition, some scholars have pointed out that tourism can have edifying and practical functions [34] and science tourism, as a form of tourism that integrates knowledge and tourism, is better suited to these functions. If university towns are included in the design of popular science tourism routes, the distance between the public and universities can be reduced. Subsequently, the advantages of university towns in promoting science to the public can be introduced.

In Guangzhou, representative science resources, such as the South China Botanical Garden and the Guangdong Science Centre, have been developed in recent years, gradually becoming essential attractions for science tourism in Guangzhou; however, universities do not currently play a role. Guangzhou University Town, which contains many universities and resources for science tourism, is a pioneer in the development of university towns in China. Using Guangzhou University Town as the starting point for science tourism using university resources in China, its influence on science tourism can be used to inform other university towns in China on how to promote science tourism and expand the scope of science tourism in China. In addition to university resources, Guangzhou University Town contains a wealth of other types of tourism resources, such as Guangdong Science Centre, Lingnan Impression Park, and the Wetland Park, making it easy to explore the linkage between university resources and other natural or humanities and social science resources in the development of science tourism.

In general, science tourism outside of China is more developed than that in China [35,36], which is still in its infancy. Although science tourism projects started earlier in certain countries, these are mainly industrial projects, and they are gradually moving towards high technology. During our survey, we found that though some universities held these activities for a few years, there is a lack of data about science tourism in universities, especially visitor data. This is due to the fact that most universities do not pay attention to registering and keeping data on the number, age, and gender of visitors when organizing science tourism, but only as a basis for verifying the presence of visitors. It can be found that the current university science tourism, as an emerging unconventional tourism project, is in great need of formal guidance and training in terms of supervision, record keeping, and other areas.

There is an urgent need to strengthen theoretical research and technical improvements to fully explore the potential of the science tourism industry and to enhance the value of science popularization.

### *1.2. Land Suitability Evaluation*

In terms of land suitability evaluation, different scholars have provided unique insights. In his theory on land suitability evaluation, McHargue advocated that a suitability analysis should be carried out according to the natural properties of the land to ensure the value of the land to the natural environment and introduce the economic value of the land. This viewpoint is also applicable to the suitability evaluation of science and technology tourism sites [37].

At present, suitability assessments of tourism sites generally begin from the perspectives of mountain topography, climate comfort, and land use [38], mainly from a natural standpoint to examine its impact on various aspects of tourism. Suitability assessments have been used for assessing pension tourism [39], urban greenways [40], and rural development [41]; however, there has been few studies on popular science tourism. In terms of methodology, geographic information system (GIS) has been used as the primary tool for evaluating the suitability of tourism development from the perspectives of tourism comfort [42], tourism competitiveness [43], and ecological sensitivity [44]. Previous studies generally evaluated tourism from a single perspective; however, some studies combined

various factors to form a set of evaluation criteria and applied these criteria to assess suitability for development in a specific area of science tourism. In contrast to previous studies where weighting was based on expert assignments, the assignments in these studies were made using the hierarchical analysis method, with experts adjusting the weights objectively. The difference in importance of each element in the evaluation system can be derived and can be combined with the spatial analysis method and buffer zones to provide references for the construction of supporting facilities for science tourism sites, as well as provide a more objective and comprehensive evaluation of existing science tourism sites. Therefore, this paper will take universities as the carriers of science tourism, explore their unique science resources, and objectively evaluate their science value and development potential.

Taking Guangzhou University Town as a case study, this study combines science tourism with tourism resources to evaluate the suitability of science tourism sites, focusing on university resources for science tourism. The weights of each factor are determined by constructing matrices, which are then combined with hierarchical analysis to evaluate their potential for development and use. Popular tourism sites are then graded, and several tourism routes are designed to provide a theoretical basis for the rational development of popular science tourism in Guangzhou University Town and to determine the types of tourism activities and scale that university towns can provide in popular science tourism.

## 2. Overview of the Study Area, Research Methodology, and Data Sources

### 2.1. Overview of the Study Area

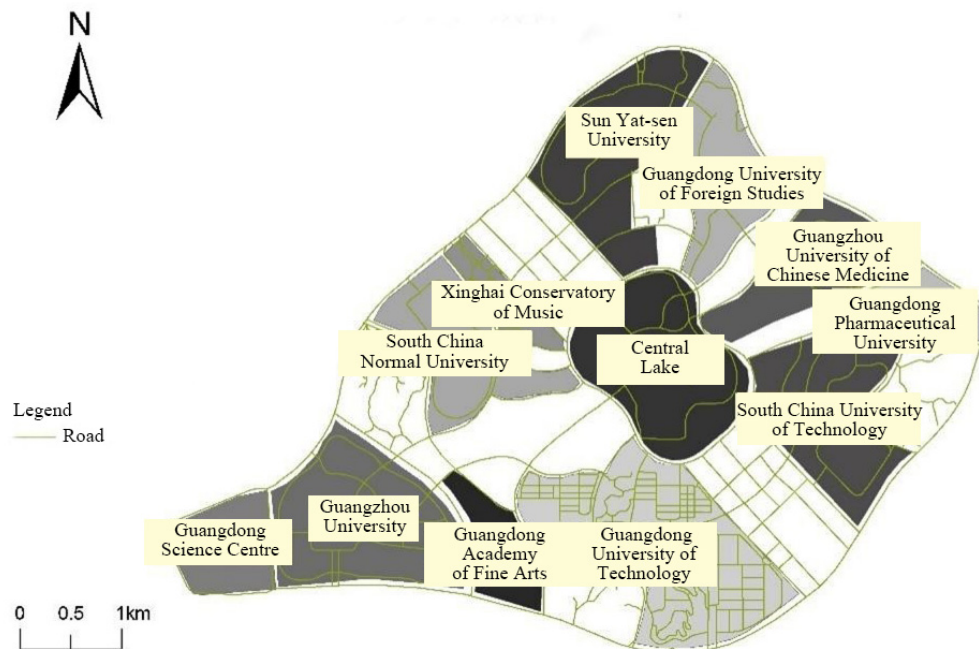
At present, although Guangzhou's tourism industry is highly developed, the number of attractions developed in recent years is relatively small and the focus is on cultural tourism (e.g., the construction of the "Super Wenheyong"). Guangzhou University Town is located in the eastern part of Guangzhou, on the island of Xiaoguwei, Xinzao Town, Panyu District, with a planned area of 43.3 km<sup>2</sup>. The university town houses ten universities, historical and cultural heritage, and museums. It is currently the most significant investment project among university towns in China [45]. The rich tourism land resources in the town are the basis for tourism development, as well as the basic agglomeration unit for spatial tourism organizations. Lingnan history, ancient folk culture, Guangdong Science Center, and university construction in Guangzhou University Town complement each other, forming rich and diverse tourism resources in the city [46]. The landscape resources of university towns are classified as cultural tourism and historical sites [47]. The functions of the tourist sites in the university town include sightseeing tourism, which contains Lingnan vernacular and Lingnan folk culture and special tourism, such as enriching knowledge and increasing the experience of tourism [48,49]. Therefore, Guangzhou University Town has high scenic quality and aesthetic value, extending and assimilating the city's historical and cultural resources on three levels: material cultural layer, behavioral cultural layer, and conceptual cultural layer [50]. Figure 1 is a schematic diagram of the distribution of various blocks in Guangzhou University Town.

### 2.2. Evaluation Index Selection

The quality of science tourism sites mainly depends on the indicators of the extended attributes of tourism resources, tourism areas, and location conditions within the tourism sites [51]. In this study, based on existing evaluation methods [52–56], combined with relevant graphic information collected by the natural resources and planning departments and relevant textual information, the evaluation factors of different scales were selected from the macro and micro perspectives and combined with the actual situation of the university town area to establish an evaluation system for the development of science tourism sites. The following five items were selected as indicators for the evaluation of the quality of popular science tourism sites in Guangzhou University Town: (1) scale capacity, including the ratio of the area of land available for tourism to the area of all tourism land (expressed as S1); (2) environmental level, mainly the vegetation coverage of tourism sites; (3) resource level, including natural science popular tourism resources and humanistic



science popular tourism resources; (4) service conditions, including infrastructure (communication, power supply, water supply), service conditions (accommodation and other services), and equipment conditions; and (5) location conditions, including accessibility and traffic conditions (road conditions, convenience, safety).



**Figure 1.** Distribution of areas of Guangzhou University Town.

### 2.2.1. Size and Capacity

The tourism environmental capacity was determined according to the area capacity method considering theories in ecology, environmental protection, tourism, sociology, economics, and education, and national regulations and relevant norms, which determine tourism environmental capacity (e.g., Environmental Protection Law of the People's Republic of China) [57–62]. The three methods of estimating tourism environmental capacity are the area capacity method, the route capacity method, and the chokepoint capacity method. Each of these methods are more applicable to different tourism scenic areas and tourism environments. Therefore, when conducting tourism environment capacity estimation, it is necessary to first determine the type of tourism functional area or tourism environment and then determine the basic parameters according to the characteristics of different tourism environments. Science tourism in Guangzhou University Town includes ten famous universities, cultural monuments from the Han and Tang dynasties to the present day, and other high-quality resources. The attractions are mainly distributed in blocks and the touring method is primarily based on land, so it is suitable to use the area capacity method for estimation.

$$C = (A/a) \times D$$

where  $C$  is the daily environmental capacity in person-times,  $A$  is the visitable area in  $m^2$ ,  $a$  is the reasonable area or minimum area that each visitor should occupy in  $m^2$ , and  $D$  is the turnover rate (time the site is open, or the time required to complete the site).

The area capacity method calculates the daily environmental capacity of the touring area according to the formula based on indicators, such as the tourist area of the science tourism area, space reasonably occupied by visitors, opening hours, and time required for touring.

### 2.2.2. Environmental Level

Combined with relevant studies [63–66], since the vegetation in the university town is arranged by each university according to the campus pattern and the needs of science popularization, the normalized vegetation index (NDVI), a method of calculating the vegetation coverage degree by combining the red and near-infrared bands according to the spectral characteristics of vegetation, was used to calculate the vegetation distribution of Guangzhou University Town and to assess the greening degree of each science popularization tourist site.

$$NDVI = (NIR - R)/(NIR + R)$$

where NIR is the reflection value in the near-infrared band and R is the reflection value in the red band. The calculated NDVI index is less than 0 for water bodies, 0 for buildings, and greater than 0 for vegetation and these values can be used to classify the land use of Guangzhou University Town into these three types.

### 2.2.3. Resource Level

The resource level refers to the current science tourism resources in the tourism area. Combining the results of recent research on science popularization tourism resources in China [67] and the characteristics of the object and the scale of the study, the science popularization tourism resources in this study were defined as either facilities with knowledge science popularization value (e.g., science popularization bases, exhibition halls, ecological gardens, and historical and cultural sites) or activities with knowledge science popularization value in fixed places (e.g., student bijou exhibitions, stalls displaying the achievements of associations). Popular science tourism resources are an essential indicator for assessing whether a tourist destination has the value of popular science tourism. The importance of popular science tourism development in tourist destinations with popular science tourism resources is often higher than that in those without popular science tourism resources. If a tourist destination has fewer science tourism resources, it is necessary to invest in tourism development to enhance the value of tourism in the destination.

### 2.2.4. Service Conditions

Combined with the characteristics of science tourism in Guangzhou University Town and based on the principles of scientificity and operability, this study used catering as an evaluation factor to evaluate the level of service conditions in each block of Guangzhou University Town. Considering that universities differ from traditional tourism industry subjects, some elements from previous studies on science tourism [25,68] were not suitable as reference factors for evaluation. However, since popular science tourism has tourism at its essence, catering was included in the evaluation of service conditions as the evaluation standard. The primary method of the assessment was the use of Arcadia. The preliminary evaluation method used ArcGIS tools to create three levels of buffers on each tourist area and overlay them with the dining area to obtain the distance between each tourist location and the nearest dining area.

### 2.2.5. Location Conditions

In evaluating the location conditions of science tourism, the convenience of transportation plays a crucial role as it affects tourists' choice of science tourism destination [69–71]. Guangzhou University Town is included in a four-in-one urban transportation system, which includes "Guangzhou highway transportation (Beijing-Zhuhai Expressway and Central City Express Line), rail transportation (Metro Line 4 and Metro Line 7 'cross intersection'), general road transportation, and broadband network information transportation". The diverse transport needs of university towns can be met to the greatest extent possible within these network systems. The university town is ideally located in a central position between some of Guangzhou's major scenic spots, such as the Whampoa Military

Academy, Yu Yin Shan Fang, Bao Mo Yuan, Xiang Jiang Safari Park, Chang Long Happy World, Pazhou International Convention, and Exhibition Center, and Guangzhou Bio Island, making it a unique tourist location. Therefore, this study used GIS to calculate the nearest distance by road from each plot of Guangzhou University Town to University Town North Station, University Town South Station, and Nansha Express University Town Exit to analyze the locational relationship.

### 2.3. Determination of Evaluation Index Weights and Consistency Test

#### 2.3.1. Construction of Judgment Matrix

We used the “1 to 3 scale method” [71–76] to construct the judgment matrix, with 1, 2, and 3 indicating that the indicator is equally important, more important, and obviously more important than the other when comparing two indicators; the inverse shows the opposite comparison of the two indicators. According to the evaluation hierarchy model, judgment matrices of the suitability of science tourism sites and the location conditions were constructed. Professors from several schools and organizations, including Guangzhou University, South China Human Geography, Urban Development Research Centre, and Nanning Normal University, were then invited to discuss and determine the final assigned values (Table 2).

**Table 2.** Hierarchical model and index weights for the suitability evaluation of popular science tourism in Guangzhou University Town.

General Objective A Level	Evaluation Indicator B Level	Evaluation Factor C Level
Suitability of the science tourism site	Service conditions (0.143)	Catering (0.143)
	Location conditions (0.143)	Higher Education Mega Centre North Station (0.047)
		Higher Education Mega Centre South Station (0.047)
	Scale capacity (0.143)	Highway entrance and exit (0.0047)
	Resource level (0.428)	Environmental degree (0.143)
Environmental level (0.143)	Number of attractions (0.428)	
		Vegetation cover (0.143)

#### 2.3.2. Calculating the Weights of Each Evaluation Index

The  $n$ th root of the product of the elements of each row of the judgment matrix were calculated to obtain the square root vector  $T_i$ :

$$T_i = \sqrt[n]{\prod_{k=1}^n X_{ik}}, (i = 1, 2, \dots, n) \quad (1)$$

where  $n$  is the number of evaluation factors and  $X_{ik}$  ( $i = 1, 2, \dots, n; k = 1, 2, \dots, n$ ) is the judgment value obtained by comparing the relative importance of the  $i$ th indicator with that of the  $k$ th indicator.

The square root vector  $T_i$  was normalized to obtain the relative weight value of each indicator in the layer close to a particular indicator in the upper layer.

$$W_i = \frac{T_i}{\sum_{i=1}^n T_i}, (i = 1, 2, \dots, n) \quad (2)$$

#### 2.3.3. Consistency Test

The results obtained using the hierarchical analysis method were tested for consistency across the judgment matrices to ensure the reasonableness and reliability of the results.

The maximum characteristic root  $\lambda_{\max}$  was calculated using:

$$\lambda_{\max} = \sum_{i=1}^n \frac{1}{nW_i} \sum_{j=1}^n X_{ij}W_j \quad (3)$$



Consistency indicators were calculated using:

$$I_C = (\lambda_{\max} - 1) / (n - 1) \quad (4)$$

Stochastic consistency ratio  $R_C$  was calculated using:

$$R_C = I_C / I_R \quad (5)$$

$I_R$  is an average random consistency indicator. If  $R_C < 0.100$ , the judgment matrix passed the consistency test. The  $R_C$  of the evaluation hierarchy model constructed in this study was 0.000, which passed the consistency test.

#### 2.3.4. Calculation of Suitability Scores

Based on the weights of the obtained evaluation indicators, the scores of the different evaluation factors for each tourism site in the university town were determined. The sum of the indices for each tourism site was derived according to the following formula:

$$A = \sum_{i=1}^n P_i A_i \quad (i = 1, 2, \dots, n) \quad (6)$$

where  $A$  is the index sum of the evaluation factors of a tourism plot,  $P_i$  is the weight of the  $i$ th evaluation factor,  $A_i$  is the score of the  $i$ th evaluation factor, and  $n$  is the number of evaluation factors. Once the evaluation factor index and the evaluation factor of each plot were obtained, the potential level criteria could be assigned separately to determine the level of each plot.

#### 2.4. Data Sources

This study used 2018 index data of Guangzhou University Town obtained from geographic data platforms, including 2018 Guangzhou Landsat 8 remote sensing images obtained from the geospatial data cloud free download, with an accuracy of  $30 \text{ m} \times 30 \text{ m}$ , fieldwork, and questionnaires. Data on science resources were collected from the official websites of universities during university town and field visits. Data on tourism resources were collected by visiting tourist attractions in the town and recording the opening situation and number of attractions. The dataset contained nearly all the data on science and tourism resources. After researching the distribution of catering, it was found that due to the strict management of the university town, almost all food and beverage outlets were concentrated in several areas, as discussed in Section 3.4.

Interviews with pedestrians were obtained through field research conducted on multiple days from November to December 2020. We counted the number of people at the main entrances and exits of each university during weekends during the same period to ensure the scientific validity of the data. In addition, we randomly distributed questionnaires and collected 120 valid questionnaires through various means. The results of the questionnaire are presented in Section 3.6.

### 3. Results

#### 3.1. Comparative Analysis of Daily Environmental Capacity

The environmental capacity of science tourism in Guangzhou University Town was calculated according considering the minimum area of  $601 \text{ m}^2$  per visitor as stipulated in the Planning Code for Scenic Areas; the number of visitors that can be accommodated in each plot is shown in Figure 2, with a total capacity of 129,108 visitors per day. The areas with high daily environmental degrees were mainly located in the Central Lake, Guangdong University of Technology, Guangzhou University, Guangzhou Chinese Medicine and Pharmaceutical, and Sun Yat-sen University plots. The Guangzhou University, Sun Yat-sen University, and South China University of Technology plots had advantages in terms

of visitor capacity, whereas the Guangzhou Academy of Fine Arts and the western part of Guangzhou International Innovation City plots had the lowest daily environmental capacity and could not accommodate many visitors, which is a disadvantage for these plots as prospective science tourism bases.



**Figure 2.** The daily environmental capacity of Guangzhou University Town (601 m<sup>2</sup> per person).

### 3.2. Comparison of Environmental Level

Table 3 of the land-use of Guangzhou University Town shows that the proportions of the areas of vegetation, buildings, and water bodies in Guangzhou University Town are 40%, 52%, and 8%, respectively. The total proportion of green areas and water bodies was 48%. Overall, Guangzhou University Town has high vegetation cover and a high degree of greenery, which is suitable for tourism and leisure.

**Table 3.** Land use of Guangzhou University Town.

Tourism Block	Vegetation (%)	Buildings (%)	Water Bodies (%)
Overall	40	52	8
Guangdong Science Centre	18	66	15
Lingnan Impression Park	67	28	4
The second Mausoleum Museum of the Southern Han Dynasty	70	29	1
Guangzhou University	22	68	10
Guangdong University of Technology	36	48	16
Guangzhou Academy of Fine Arts	22	56	22
South China University of Technology	24	65	11
Guangzhou University of Chinese Medicine—Guangdong Pharmaceutical University	15	76	9
Guangdong University of Foreign Studies	15	78	7
Sun Yat-sen University	23	72	5
Xinghai Conservatory of Music—South China Normal University	30	61	9
Guangzhou International Innovation City West	38	53	8
Central Lake Park	50	35	15
Wan Jutou Wetland Park	76	23	1
Chikan Wetland Park	77	22	1
Bei Gang Wetland Park	76	17	7

The land use of each plot shows that the environmental levels of natural science resources were significantly higher than those of human science resources. The highest percentage of vegetation was found in park-type plots, such as Wan Jutou Wetland, Chikan Wetland, and Bei Gang Wetland, all located in the outer ring. The Guangdong Science Centre, International Innovation City West, and various other universities had lower percentages of vegetation. The plots with the lowest greenery rate were Guangzhou University of Chinese Medicine, Guangdong Pharmaceutical University, and Guangdong University of Foreign Studies.

### 3.3. Distribution of Science Tourism Resources

The science tourism resources table distribution shows that human science tourism resources are the most critical science resource in Guangzhou University Town. The current natural science tourism resources in the university town are scarce and the degree of development is low. The plots of Guangdong Science Centre and Lingnan Impression Park are rich in science tourism resources. They have the lowest development difficulty and investment cost for developing as science tourism bases. The plots of Guangzhou University, Guangzhou University of Chinese Medicine—Guangdong Pharmaceutical University, Central Lake Park, and Xinghai Conservatory of Music—South China Normal University have some science tourism resources. In contrast, the Wan Jutou Wetland, Chi Kan Wetland, and Bei Gang Wetland plots have the lowest science tourism resources and are the least developed and, therefore, have the most severe difficulty in developing science tourism (Table 4).

**Table 4.** Distribution of Popular Science Resources in Guangzhou University Town.

Tourism Plots	Science Resources	Total Number
Guangdong Science Centre	Low Carbon and New Energy Vehicles Science Experience Hall, People and Health Hall, Green Home Hall, Innovation Space Hall, Digital Paradise Hall, Materials Park Hall, Transport World Hall, Children’s World Hall, Experiments and Discoveries Hall, Lingnan Science and Technology Exhibition, Flying Dreams Pavilion, Sense and Think Pavilion, Science Square, Robotics Lab, AR Lab, 3D Printing Creative Design Lab, Solar Cell Production Lab	17
Lingnan Impression Park	Old Wine Shop, Old Barber Shop, Lion Dance Club, Lingnan Art and Culture Exhibition, Canton Embroidery Museum, Nun’s House, Guangdong Broadcasting Museum, Old Newspaper House, Big House, Old Cinema, Old Photo Gallery, Guangdong TV’s “Chen Mengji” Filming Base	12
The second Mausoleum Museum of the Southern Han Dynasty	Southern Han History Exhibition Hall, Archaeological Research Specimen Showroom, Public Archaeological Simulation Centre	3
Guangzhou University	Planetarium Science Base, Optoelectronic Science Base, Science Building North Building Student Works Exhibition, School History Exhibition Hall, Clubs Achievement Exhibition, Performing Arts Centre, He Shijie Gymnasium	7
Guangdong University of Technology	Industry 4.0 Experimental Base, Society Achievement Exhibition, Cultural Exchange Centre, Creative Center of Guangdong University of Technology	4
Guangzhou Academy of Fine Arts	Art Museum Sculpture Branch, Art Museum of Guangzhou Academy of Fine Arts, Association Achievement Exhibition, Liang Mingcheng Sculpture Garden	4
South China University of Technology	Exhibition of students’ innovative design works, exhibition of club achievements, South China University of Technology Library	3

Table 4. Cont.

Tourism Plots	Science Resources	Total Number
Guangzhou University of Chinese Medicine -Guangdong Pharmaceutical University	Guangdong Pharmaceutical University Human Science Education Centre, Guangdong Pharmaceutical University Chinese Medicine Herbarium and Medicinal Botanical Garden, Guangdong Digital Home Interactive Application Engineering Laboratory, Guangdong Museum of Chinese Medicine, Guangdong Pharmaceutical Society Achievement Exhibition, Guangdong Chinese Medicine Society Exhibition	6
Guangdong University of Foreign Studies	Octagon House, Club Achievement Display	2
Sun Yat-sen University	Statue of Dr. Sun Yat-sen, Forest of Three Quotations, Society Achievement Exhibition	3
Xinghai Conservatory of Music-South China Normal University	Xinghai Conservatory of Music Concert Hall, Conservatory of Music hall of South China Normal University, Beigang Villagers' Traditional Residence, Sports Park of College town Campus of South China Normal University, Xinghai Club Achievement Exhibition, Club Achievement Exhibition of South China Normal University	6
Guangzhou International Innovation City West	Guangzhou National Archives, Guangzhou International Innovation City Exhibition Hall, Guangzhou Patriotic Education Base	3
Central Lake Park	Guo Long Guo Clan Ancestral Hall, Bauhinia Garden of Guangzhou University Town, Central Lake Cultural Square of Guangzhou University Town, Guangzhou Literature and Art Creation Centre, Sports Centre of Guangzhou University Town	5
Wan Jutou Wetland Park	Waterfowl Habitat Wetland	1
Chikan Wetland Park	Waterfowl Habitat Wetland	1
Bei Gang Wetland Park	Waterfowl Habitat wetland	1

### 3.4. Location of Tourist Sites and Catering Areas

The catering distribution map (Figure 3) shows that catering areas in Guangzhou University Town are primarily distributed between the central ring and the inner ring, and that the tourist plots located in this zone have good catering service conditions. All university plots have catering areas and, thus, had the best catering service conditions. Among non-university plots, the plot of Central Lake Park, a relatively high-traffic park in the middle of the island adjacent to several universities, had a catering area within 100 m. The second Mausoleum Museum of the Southern Han Dynasty is close to the living quarters of the South China Normal University and the Guangdong University of Industry; as a result, catering areas can be found within 200 m. The Guangzhou International Innovation City West is close to the Guangzhou Academy of Fine Arts and Guangdong University of Industry and, thus, has catering areas within 300 m. Most of the remaining plots, such as Lingnan Impression Park, Wan Jutou Wetland Park, Chikan Wetland Park, and Bei Gang Wetland Park, are located on the edge of the outer ring, but the living quarters of the major universities are generally located between the inner and middle rounds. In addition, several villages with catering areas are located between the center and outer rings, making it difficult to reach catering areas within 300 m from these plots.



**Figure 3.** Distribution of catering areas of Guangzhou University Town.

3.5. Accessibility of Tourist Areas

The location table of the Guangzhou University Town tourist area (Table 5) shows that Central Lake Park has the best location conditions and is particularly close to the metro station of Higher Education Mega Center south and north. In contrast, the plots of Guangdong Science Centre, Guangzhou University of Chinese Medicine—Guangdong Pharmaceutical University, Wan Jutou Wetland Park, Chi Kan Wetland Park, and Bei Gang Wetland Park were far from the metro station and highway exit, giving them the worst location conditions and making them relatively inaccessible for tourists.

**Table 5.** Guangzhou University Town Tourism Area Location.

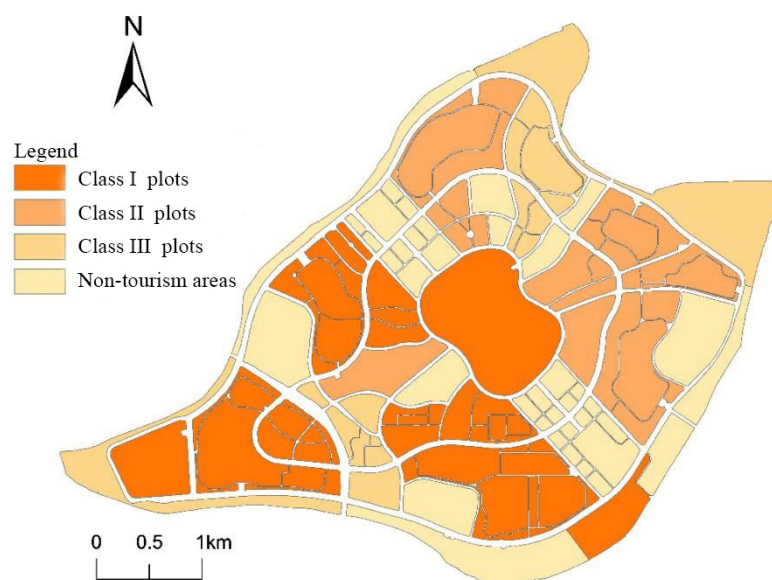
Tourism Plots	Higher Education Mega Centre North Station	Nansha Harbour Expressway	Higher Education Mega Centre South Station
Guangdong Science Centre	4.4	2.8	4.5
Lingnan Impression Park	3.3	4.6	1.5
The second Mausoleum Museum of the Southern Han Dynasty	1.9	2.1	2.3
Guangzhou University	2.9	0.8	2.5
Guangdong University of Technology	2.9	2.9	0.8
Guangzhou Academy of Fine Arts	3.8	1.1	2.3
South China University of Technology	3.3	3.3	0.8
Guangzhou University of Chinese Medicine—Guangdong Pharmaceutical University	2.7	4.2	2.6
Guangdong University of Foreign Studies	1.7	4.3	2.5
Sun Yat-sen University	0.9	3.7	3.1
Xinghai Conservatory of Music—South China Normal University	1.1	2.2	3
Guangzhou International Innovation City West	2.9	1.7	2.4
Central Lake Park	1.1	2.6	1.7
Wan Jutou Wetland Park	4.3	3.5	5.5
Chikan Wetland Park	2.7	5.4	3.9
Bei Gang Wetland Park	3.5	7.2	3.6



### 3.6. Synthesis of Evaluation Results and Validation

#### 3.6.1. Comprehensive Analysis of Evaluation Results

In this study, through field research, data analysis, expert empowerment, and theory on science tourism resources and supporting facilities, such as transportation and catering of universities and tourist attractions in the university town, a three-level system of potential level (level 1), landscape resource category (level 2), and functional type (level 3) was used to evaluate the science tourism sites in Guangzhou University Town. According to the actual situation of the university town, three tourism place potential levels were determined, that is, tourism places with high (Class I), medium (Class II), and low (Class III) tourism potential (Figure 4). Each university town site was scored according to the evaluation mentioned above. Then, the sum of the evaluation factor scores of the university town sites was calculated. The average sum of the sites' scores was used as the criterion for the corresponding potential level. The sum of the scores for each factor was the weighted index sum. Tourist sites with sums of evaluation factor scores higher than 3.1 were classified as Class I, those with scores from 2.4–3.1 were Class II, and less than 2.4 were Class III.



**Figure 4.** Adaptability evaluation results of popular science tourism destinations in Guangzhou University Town.

The results of the suitability assessment of science tourism sites in Guangzhou University Town are shown in Figure 4. The Grade I science tourism sites were the plots of Lingnan Impression Park, Guangdong Science Centre, Guangzhou University, Guangdong University of Technology, Xinghai Conservatory of Music—South China Normal University, and Central Lake Park. Class II science tourism sites were the plots of Guangzhou Academy of Fine Arts, Sun Yat-sen University, Guangzhou University of Chinese Medicine, Guangdong Pharmaceutical University, and South China University of Technology. The remaining plots were Class III science tourism sites. The overall spatial distribution shows a generally higher science tourism suitability score to the west of the central lake than to the east and a rough northeast–southwest symmetry.

#### 3.6.2. Comprehensive Verification of Evaluation Results

Grade I tourist sites had more obvious advantages in terms of science tourism resources and catering service conditions than Grade II and III tourist sites, and these were reflected in several factors with higher weights in the evaluation list, especially the number of science tourism resources.

In addition, the convenience of transportation was an essential factor affecting the rating of science tourism sites. For example, although the plot of Guangzhou University of Chinese Medicine–Guangdong Pharmaceutical University was comparable to Class I tourism sites in terms of science tourism resources, it is far away from important transportation hubs, such as metro stations and highways, and so did qualify as a Class I tourism site. The overall traffic layout of Guangzhou University Town has three ring roads: an inner ring, middle ring, and outer ring, and the two subway stations in the south and north of the university town are symmetrically distributed. However, the Nansha Harbor Expressway is in the southwest of the island and has a very close traffic connection with downtown Guangzhou; therefore, science tourism sites in the southwest of the island, such as the plots of Guangzhou University and Guangdong Science Centre, had relatively more convenient road transport and their scores in terms of location conditions were relatively higher.

This study found that some Class I tourist sites were not reasonably developed, and that the development of universities is still in the early stages. Field research to different science tourism locations and supporting facilities was conducted on the weekends and 12:00–13:00 noon peak times to study the flow of people and average values from several visits were used. The average peak flows of Central Lake Park, Guangdong University of Technology, Guangdong Science Center, Gogo Xintiandi Shopping Center, and Chikan Wetland Park were 482, 8, 102, 2712, and 2 people, respectively. These results show that the number of people going to universities for tourism activities is much lower than that of other Class I tourist destinations, such as the Guangdong Science Center. This shows that science tourism in universities still needs to be developed and implemented.

In addition, this study conducted a research questionnaire on the current transportation situation, tourism resources, tourism experience, food service, and publicity of the university town from the perspective of having traveled to Guangzhou University Town/living in Guangzhou University Town/not having traveled to Guangzhou University Town, to understand the 120 respondents' awareness and participation. Fifty-five of respondents had visited various science tourism sites, while 17, who had not visited, said they had not heard of any science tourism sites on the island. Sixty respondents thought that the popularity of science tourism in the university town was average and needed to be improved. Regarding travel options to various attractions, 55 tourists who had visited the city said they used buses, subways, and cycling more often to get to the university town. The results shows that the most common duration for popular science tourism is roughly one day, which shows the same trend as other unconventional tourism, such as visiting friends and relatives tourism (VFR) [77]. We suggest that this is because the purpose of traveling is different from conventional purposes. While VFR may not have clear goals for traveling, for popular science tourism, people are determined to learn rather than relaxing. This has been dubbed "travel craving" by some scholars [78].

The overall satisfaction rate for the convenience of transportation on the island was 3.84, indicating that there is still a need to strengthen the construction of public transit and public roads to provide more convenient and fast travel conditions for tourists. In addition, respondents usually dined in commercial areas, such as Gogo Xintiandi (the commercial center) and various dining halls in the university. However, the overall satisfaction with the general dining conditions in the university town was 3.71, indicating that there is much room for improvement in the dining conditions. The questionnaire shows that more people preferred the center of Lake Park, Guangdong Science Center, and Lingnan Impression Park due to their rich tourism resources, various characteristics, and convenient transportation. At the same time, wetland parks, such as Wan Jutou, Chi Kan, and Bei Gang were almost unattended because of their remote location and relative inaccessibility in terms of transportation conditions. Most visitors spend half a day in these science tourism places, with only a few cases of two days or more. Based on this, Guangzhou University Town's science tourism planning should focus more on enriching playable resources to attract more off-island and foreign tourists.

## 4. Discussion

### 4.1. Suggestions for Science Tourism Development

This paper suggests the following for the development of science tourism in Guangzhou University Town:

1. More roads and public transportation systems should be built to strengthen the connections with the city and improve the layout of transportation in the university town to be more symmetrical. Although the town has a complete public transportation system, the current connection between Guangzhou University Town and downtown Guangzhou is limited to two methods: by car through Nansha Port Expressway and Guangzhou Tunnel or by subway through Metro Line 7 and Line 4 of Higher Education Mega Center North and South Station. In general, the road layout is asymmetrical, and the subway station is in the center of the University Town traffic circle, meaning that areas at the edge of the university town do not benefit from the convenience and have greater commuting times. Therefore, the future infrastructure development of the university town should focus on the development of roads, the construction of highways similar to the Nansha Port Expressway in the northern part of the University Town, and the opening of subway stations, such as “University Town East and West,” which can balance the uneven traffic and distribution of Guangzhou Metro stations. These developments would also better connect the university with the Guangzhou Beltway, resulting in the university town being less isolated.
2. Efforts should be made to improve supporting service facilities on the island, plan the layout of service facilities and break the boundary to form a piece of the area with nearby villages and islands. There is some land near the universities in Guangzhou University Town that still need to be developed. The places providing catering, services, accommodation, and leisure in Guangzhou University Town are limited and are mainly concentrated in the Gogo Xintiandi shopping mall, the general commercial center, and the natural villages. Universities can only provide certain catering services and the provision of other services is more limited. Compared with the shopping malls, the natural villages provide different quality of services. The quality of services offered by universities and colleges varies, making it difficult to attract tourists to stay overnight and extend their visits. Therefore, the spatial distribution and types of land to be developed should be fully considered. Comprehensive shopping malls, parking lots, hotels, and other service facilities should be constructed for several sites that are evaluated as Class I tourist sites but have relatively low traffic (e.g., Guangdong Science Center) and those with fewer resources in terms of spatial distribution (e.g., wetland parks, northern areas of university towns). At the same time, the university town should break its boundaries between it and nearby villages and islands (Xiaozhou Village, Changzhou Island), strengthening the connections between them. This would result in the economy of the area growing rapidly and becoming an important part of the city.
3. The range of guest source radiation should be expanded. The primary source of tourists for Guangzhou University Town is Guangzhou citizens, nearby villagers, and students in the university town. While nearby villagers and students are the main groups, the university town should aim to attract more tourists from outside the island. First, the university town should increase publicity and establish a tourism company led by the government to integrate all the science tourism resources and hold activities to promote the university town science tourism, such as a college in Guangzhou University Town hosting a geology summer camp. This would attract more people from Guangzhou and the surrounding areas to visit for weekends, leisure and vacation, recreation, and fitness. Second, the university town should build more complete scientific, educational, cultural, health, and sports facilities and use the Internet and other means to attract more tourists.

#### 4.2. Outlook

This paper attempted to build a suitability evaluation index system for science tourism in Guangzhou University Town from the perspective of tourism mode. However, there were some limitations. First, many indicators affect science tourism in university towns and the results differ when different indicators are chosen. Second, the evaluation method had some uncertainties. The subjectivity of scoring weights is difficult to avoid and can affect the accuracy of the final evaluation results to varying degrees. Therefore, this requires improvement in subsequent research. Third, the evaluation of the suitability of science tourism is extremely critical in the tourism planning of Guangzhou University Town; however, because of the enormous workload of surveys and calculations, there is much information not readily available, which will lead to errors in the estimation of the number of visitors in the planning period. If this error is too large, construction planning for water, electricity, tourist beds, commercial service facilities, and other facilities becomes meaningless, and the general layout loses its basis. Therefore, it is a demanding and challenging task, but is one of great significance.

As previously discussed, university towns have the potential to be important parts of popular science tourism because they have tourism resources that are suitable for fulfilling the curiosity and demand of many people. Although university towns are built in many cities and some leaders are aware of the value of these university towns, most remain to be developed. Some environmental and social questions also need to be considered because there are not only universities and students in the university town but also villages and residents. The development of science tourism can bring social problems, such as conflicts between students, teachers, residents, and outsiders and insufficient coordination of city administration can lead to environmental damage and the accumulation of rubbish. These issues need to be considered for the development of science tourism at university and non-university tourism sites. Thus, managing this type of unconventional tourism needs great consideration. Moreover, it cannot be ignored that human traffic flow is massively different between holidays and regular times. Therefore, how the government aids merchants during the summer and winter holidays to survive in the off-season should be discussed.

#### 5. Conclusions

This study used remote sensing data and field investigation to analyze the resource value and environmental level of tourism sites considering five factors: scale capacity, ecological level, resource level, location condition, and service condition. We constructed a set of indicators to evaluate the suitability of the science tourism sites in Guangzhou University Town by combining the hierarchical analysis method and the opinions of experts to assign weights to the five factors. The suitability of the development of science tourism sites in Guangzhou University Town was evaluated through measurement and field surveys, and the main findings were as follows.

1. In the classification of the suitability of the development of popular science tourism sites in Guangzhou University Town, the five evaluation indices had higher weights in terms of resource level and location conditions. This means that the resource level was most critical factor affecting the evaluation of popular science tourism sites, followed by service conditions. In the future, the development of science tourism sites should prioritize the resource level of the region; however, other elements should still be considered.
2. Overall, the grades of popular science tourism sites of the western part of the University Town were higher than those of the eastern part, demonstrating the uneven development of the western and central regions of the University Town and the eastern regions. This uneven development is particularly evident in the number of tourism resources and the grades of popular science tourism sites, which is due to the more developed transportation in the western part.
3. The degree of development and use of tourist sites does not only depend on the abundance and characteristics of resources but also on a range of socioeconomic,

locational, and environmental conditions associated with tourism development. The development of science tourism in university towns should optimize the layout of transportation, catering, and other elements while also improving the infrastructure and service level in areas rich in attractions. They are combined with the actual situation in the town of Guangzhou University.

4. Popular science tourism is an essential part of the developing industry of unconventional tourism and Guangzhou University town is rich in resources for this industry according to our survey and dataset. Our questionnaire revealed that people prefer to only stay for one day when visiting university towns. Therefore, we suggest that the most suitable duration for popular science tourism is one day, which shows the same trend as VFR, another kind of unconventional tourism.

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