

## Article

# Research on the Spatiotemporal Distribution and Cultural Tourism Strategy of Modern Educational Architectural Heritage in Nanjing

Hechi Wang <sup>1,2,\*</sup>, Xinxin Chen <sup>1</sup>, Jianwei Ge <sup>1</sup>, Zhaoyi Yan <sup>1</sup> , Xinyi He <sup>1</sup>, Yingqiu Song <sup>3,\*</sup> and Qi Zhou <sup>4</sup>

<sup>1</sup> School of Civil Engineering, Architecture and Environment, Hubei University of Technology, Wuhan 430068, China; cxinxin202211@163.com (X.C.); weijiange9903@163.com (J.G.); zyzy1105581780@163.com (Z.Y.); 102200779@hbut.edu.cn (X.H.)

<sup>2</sup> Key Laboratory of Intelligent Health Perception and Ecological Restoration of Rivers and Lakes, Ministry of Education, Hubei University of Technology, Wuhan 430068, China

<sup>3</sup> Faculty of Education, Shenzhen University, Shenzhen 518060, China

<sup>4</sup> School of Architecture, Architectural History and Theory, Southeast University, Nanjing 210096, China; 101001781@seu.edu.cn

\* Correspondence: wanghechi@163.com (H.W.); songyq@szu.edu.cn (Y.S.); Tel.: +86-153-9154-3422 (H.W.); +86-136-3266-3068 (Y.S.)

**Abstract:** The rebirth of educational architectural heritage plays an important role in the urban tourism economy, and studying the integration of educational heritage and tourism is of great significance and value. This article selects the educational heritage in Nanjing, China, from 1840 to 1952 as its research object to explore the integration and sustainable development relationship between heritage utilization and tourism. This article adopts a research method that combines qualitative and quantitative methods. First, it collects historical data and conducts on-site surveys to obtain information on 117 important educational heritage sites in Nanjing. Then, it uses ArcGIS technology to quantitatively analyze the evolution rules of modern educational buildings in Nanjing and the spatiotemporal distribution characteristics of the heritage. Finally, a cultural tourism strategy is proposed based on heritage characteristics and government policies. The research results reveal the interdependence and sustainable development relationship between the protection and utilization of educational heritage and tourism: according to the distribution characteristics of the heritage in the urban space, the "educational heritage tourism path" of the ancient city is constructed, which can promote the development of urban tourism. Subsequently, the economic value created by tourism is used to "feed back" heritage protection. This research result provides reference for educational heritage tourism in other cities in China and around the world.

**Keywords:** educational architectural heritage; GIS; temporal and spatial distribution; tourism strategy; Nanjing



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## 1. Introduction

Educational architectural heritage represents the development of social cultural forms and educational development, and due to its unique cultural characteristics, it occupies an important position in architectural heritage. Protecting and researching educational architectural heritage have always been important in academic circles. European and American countries have preserved a number of excellent historical campuses, and their educational heritage is mainly university campuses. In 1966, the United States promulgated the National Historic Preservation Act, which included many campuses in the National Register [1]. Educational buildings that have existed for more than 50 years are required to strictly follow protection guidelines, and historical campuses such as Harvard University and the University of Chicago have been well protected [2]. At the beginning of the 20th century, the United Kingdom revised the Ancient Monuments Act, particularly for the

systematic protection of university campuses built in the Middle Ages, such as Oxford University and Cambridge University, and formulated a series of protection regulations [3].

At present, a number of modern educational buildings and historical campuses are well preserved in China. In 1961, the Red Building of Peking University was included in the first batch of national cultural relic protection units as an educational building [4]. In 1982, the Law of the People's Republic of China on the Protection of Cultural Relics [5] marked the official establishment of the protection system for cultural relics and provided legal protection for the protection of cultural heritage. In 1985, China joined the Convention Concerning the Protection of the World Cultural and Natural Heritage. So far, 56 heritage sites have been included on the World Heritage List [6], but there are very few educational buildings among these heritage sites. By 1988, in the third batch of national cultural relic protection units, modern educational architectural sites such as the former site of Huangpu Military Academy, the early buildings of Tsinghua University, and the early buildings of Wuhan University were added. Presently, there are more than 80 educational building sites among the eight batches of national key cultural relic protection units announced by China [7], including single buildings and groups of buildings on campuses, and some historical campuses are under overall protection. However, the exploration of educational architectural heritage in China is far from ideal. From the perspective of urban development, research on educational architectural heritage should not lag behind research on other historical and cultural heritage but should take the lead in protecting and utilizing such city heritage to accomplish deep exploration and achieve the sustainable utilization of urban cultural resources [8].

Currently, the existing protection and utilization of educational architectural heritage and the relevant legal and policy systems are not differentiated from those other types of heritage. Generally speaking, the research and utilization of educational heritage and policies covering it are still in an independent and decentralized state; comprehensive analysis at the regional level and the construction of a system for protection and utilization are lacking.

A famous historical and cultural city, Nanjing was once the capital of the Republic of China. It represented the most advanced education level at that time [9], witnessed the development of education for nearly a century, and has the richest architectural heritage of modern education in China. There are many types of modern schools in Nanjing, including schools founded by Chinese and Western churches; they have a complete system, including primary and secondary schools and universities, leaving a valuable legacy for follow-up schools and laying a foundation for education in Nanjing today. Therefore, it is appropriate to choose the modern educational heritage of Nanjing as the research object.

## 2. Literature Review

Currently, a variety of methods are used in academia to study architectural heritage. GIS technology has been widely used in the field of heritage protection. For example, Box [10] conducted research on the application of GIS in resource management in cultural relics and archeology. Agapiou [11] used GIS technology to conduct research on the risk assessment of cultural heritage in the Pafos area of Cyprus. This technology can more accurately reflect the situation based on the environmental parameters around heritage sites. Hu [12] applied GIS technology to study the Zhenjiang Xijindu Historic Block, and to the whole process of investigating the current situation of the protection and management of the historical block through data collection, input, storage, and analysis. In addition, GIS technology can be used to analyze the temporal and spatial distribution of cultural heritage to visualize its distribution in regional space, objectively analyze spatial distribution characteristics and evolution rules [13], and provide a more intuitive and scientific basis for subsequent utilization and protection decisions [14].

In recent years, with the international emphasis on protecting architectural cultural heritage and the growth of international tourism, in order to make full use of urban historical space and activate tourism resources, scholars at home and abroad have begun

to pay attention to the integrated development of culture and tourism. Richards [15], for example, interprets heritage tourism as a product or process, and in order to connect tourism motivation and heritage tourism, we must explore the most common manifestations of the former. Gordon [16] believes that in heritage management, we should have a broader understanding of website value, pragmatic management, and active display; enhance tourist attractions; and highlight economic or social advantages to inheriting and carrying forward traditional culture. Wiendu Nuriyanti [17] believes that in order to promote the development of modern tourism, it is necessary to properly solve the four common problems of heritage tourism, specifically, to pay attention to explaining tourism and the related promotion and planning and the interaction between heritage tourism and surrounding communities. Zhang [18], who studied the interdependence of culture and tourism, believes that cultural resources are a key component of the attractiveness of tourist destinations, which can offer a spiritual experience and generate aesthetic feelings for people and provide content for tourism development and management. Focusing on the influencing factors of cultural tourism, Tolina [19] used mixed research methods to summarize and test 15 key factors for the sustainable integration of heritage and tourism, including community engagement, education and training, authenticity and interpretation, sustainability-focused tourism management, and integrated planning, among others. Li [20] conducted research on the mode and path of integrating cultural heritage and tourism and noted that regional case studies on the topic are relatively mature. The study pointed out that in the future, it can be expanded by combining resources, integrating products, combining channels, integrating systems, and other paths. Through the comprehensive analysis of the relationship between cultural heritage and tourism, influencing factors, development models and paths. We can find that people usually pay more attention to the value conflict between cultural heritage and tourism, but ignore the importance of heritage science education and the diversified transmission of history and culture. Therefore, subsequent research needs to relate to cultural tourism education and the sustainable development of heritage.

Today, research tourism is the frontier and hot spot of international academic circles. Chinese academics have only proposed the concept of research tourism recently, lagging behind Western scholars, but the research has developed rapidly in recent years. Scholars at home and abroad mainly focus on the role of research travel and product development. For example, Cohen [21] carried out research trips in Israel focused on community participation, integrating Jewish culture and community culture in research activities through relic archaeology, outdoor hiking, and other activities. Qiu [22] regards Jiangsu's intangible cultural heritage as a good tourism resource to combine research and study travel and to vigorously develop related products in order to enrich its content. Li [23] took Chongqing Hongyan Base as the research object, conducted an in-depth discussion and analysis on its actual development and construction problems, and provided corresponding improvement strategies for the problems in order to promote long-term and sustainable development and lay a solid foundation for its orderly construction and sound development.

The above literature review shows that the current academic research on heritage and tourism is mostly focused on qualitative research and less on quantitative research, and the research content and methods are relatively singular. Especially for the current emerging tourism, there is a lack of research on the combination of culture, educational heritage, and tourism. In view of this, this paper takes the ancient city of Nanjing as an example and uses GIS technology to visualize the temporal and spatial distribution of its modern educational architectural heritage. In this way, we can deeply integrate heritage and tourism to create a multidimensional, multilevel, systematic cultural tourism strategy.

The innovations of this paper are as follows:

1. It combines qualitative and quantitative methods, using historical data and on-site surveys to collect heritage information, and uses ArcGIS technology for the first time to comprehensively, deeply, and systematically analyze the evolution law of

modern educational buildings in Nanjing and the temporal and spatial distribution's characteristics.

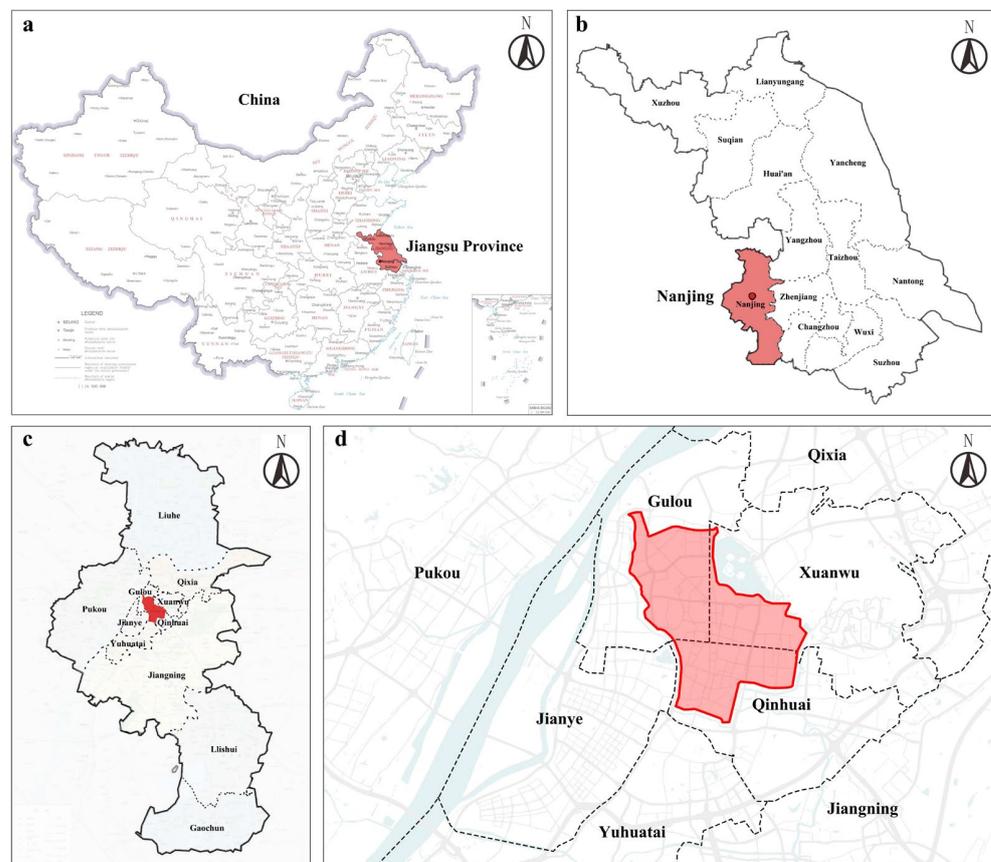
2. Based on the statistics of the number and level of existing heritage sites and in accordance with the government's policy of creating tourism through culture and promoting culture through tourism, for the first time, the path of culture, education, research, study, and tourism is proposed for the ancient city of Nanjing. We construct a point-axis-surface tourism system, create cloud tourism and on-site tourism models, and propose feasible tourism development strategies.
3. It explores a sustainable development model for heritage and tourism to realize the activation and utilization of heritage and adjust the tourism economy to feed back into the restoration of heritage.

### 3. Materials and Methods

#### 3.1. Materials

##### 3.1.1. Study Area

Nanjing is in Jiangsu Province, China, close to the Yangtze River, with convenient transportation and a developed economy. It was once the capital of the national government and a missionary base for Western churches. It has a rich school architectural heritage. Due to the expansion of cities in recent years, the current scope of Nanjing is quite different from that of historical Nanjing City [24]. This paper takes the main urban area of Nanjing as the research scope (Figure 1), and the time range is defined as 1840–1952; 1840 was the beginning of modern history and of modern education in Nanjing, and the structure of today's universities was established after the reorganization of colleges and universities in 1952 [25].



**Figure 1.** (a) Location of Jiangsu Province in China; (b) location of Nanjing in Jiangsu Province; (c) location of Nanjing's main urban area; (d) scope of main urban area of Nanjing. Base map source: Standard Map Service (<https://www.resdc.cn.4>, accessed on 31 July 2023).

### 3.1.2. Data Sources

The data came from “Historical Research on Modern Educational Architecture in Nanjing” and “Comprehensive Survey of Modern Educational Architecture Heritage in Nanjing”. Since 2011, Professor Zhou Qi’s team from Southeast University has conducted a systematic and comprehensive investigation of Nanjing’s modern architecture, including its modern educational architecture. The team gathered relevant historical data to build an inventory of all schools that existed in Nanjing’s modern history. The sources of historical materials were divided into two categories: the historical map of Nanjing City, Nanjing Archives, Nanjing Education Chronicle, Nanjing Jianzhi Chronicle, and historic materials of various schools; and related works, including “Research on Modern Educational Architecture in Nanjing (1840–1949)” by Wang Hechi [26], “Overview of Modern Chinese Architecture in Nanjing” by Liu Xianjue, Zhang Fuxing, Muramatsu Shin, and Terahara Joji [27], and “Nanjing Republic Architecture” by Lu Haiming, Yang Xinhua, and Pu Xiaonan [28]. From 2011 to 2022, Professor Zhou organized field research and systematic compilation involving more than 20 doctoral and master’s students based on the directory, including GIS acquisition, historical maps, architectural drawings, photos, on-site surveys and maps, written records, heritage overviews, archive materials, and interviews with relevant personnel. The census work used the unified Nanjing Modern Educational Building Survey, which was divided into the Nanjing Modern Chinese Educational Buildings/Structures Survey and the Nanjing Modern Church Educational Buildings Survey. A summary is shown in Table 1 [13].

**Table 1.** Summary of survey of modern educational architecture in Nanjing.

Sort	Catalog
School investigation	Original name of school, current name of school, address, scale, date of establishment, location of relics, number of historical buildings, site area, area of historical buildings, ownership unit, etc.
Building investigation	Number, original name of building, current name of building, architectural style, architectural value, building use, building address structure, scale, design time, completion time, design unit

The educational buildings described in Table 1 are defined as new-style schools in modern Nanjing influenced by Western learning and introducing Western teaching content and methods, and they exclude traditional Chinese teaching institutions. New-style schools include the complete set from kindergarten to higher education in Nanjing’s modern education history. Modern schools are divided into local and church schools according to the subjects covered and into primary and secondary schools (including elementary, middle, secondary normal, and secondary vocational schools) and colleges and universities (including junior colleges and universities) according to the level.

## 3.2. Methods

### 3.2.1. Research Methods

We first collected historical data and current heritage information, compared and analyzed them to obtain heritage information, and then used GIS technology for quantitative analysis. The research process was as follows: We imported base map element data, including important geographical information such as the main urban area of Nanjing and surrounding districts and counties, main road systems, Ming city walls, etc., and the data of modern school sites in GIS format obtained from the above-mentioned census. Based on this, we used the GIS analysis functions—kernel density, standard deviation ellipse, and buffer zone—to generate corresponding graphs. In this process, GIS provides a platform for superimposing the data. The various analysis tools included in GIS help to visualize

the results more accurately and quickly and present the results more accurately, objectively, and directly.

### 1. Kernel density analysis

Kernel density analysis was used to visualize and abstract the overall distribution of modern educational buildings in Nanjing in different periods, which facilitates the comparison of changes in different periods. The kernel density function was used to correlate modern educational buildings for probability estimation. Based on kernel density estimation, the spatial distribution of modern educational architectural heritage in Nanjing was analyzed based on time stages, to obtain the development and evolution law. The commonly used kernel density estimation formula [29] is as follows:

$$R(x) = \frac{1}{nh} \sum_{i=1}^n k\left(\frac{x - x_i}{h}\right) \quad (1)$$

where  $R(x)$  is the probability value of element  $R$  at  $x$ , and in this study,  $R$  is modern education legacy;  $k(x - x_i/h)$  is the kernel function, where  $(x - x_i)$  is the distance from the estimated value point  $x$  to the modern educational heritage  $x_i$ ; and  $h$  is the bandwidth, which is greater than 0. After analysis, the kernel function has the least impact on the result,  $h$  has a greater impact, and there is no authoritative formula for determining the value of  $h$ . According to the capital plan, after many calculations, it is determined that the value of  $h$  is 1.0 km.

### 2. Standard deviation ellipse

The standard deviation ellipse was used to analyze the main distribution range, direction trend, and agglomeration degree of Nanjing's educational buildings in each period. Mean center analysis can determine the center of gravity and its movement trend in different periods. The migration of the spatial coordinates of the mean center in different periods can represent the change trend of the spatial distribution of educational heritage. The area of the calculation range represents the size of the distribution range, the direction of the short axis represents the distribution range, and the direction of the long axis reflects the direction trend of element distribution. The larger the flatness value, the higher the degree of spatial aggregation [30,31]. The formula is as follows:

$$C = \frac{1}{n} \left( \begin{array}{cc} \sum_{i=1}^n \bar{x}_i^2 & \sum_{i=1}^n \bar{x}_i \bar{y}_i \\ \sum_{i=1}^n \bar{x}_i \bar{y}_i & \sum_{i=1}^n \bar{y}_i^2 \end{array} \right), \left\{ \begin{array}{l} (x_i - \bar{x}') \\ (y_i - \bar{y}') \end{array} \right\} \quad (2)$$

In the formula,  $x$  and  $y$  are the average centroid coordinates,  $x_i$  and  $y_i$  are the coordinate values of the  $i$ th element, and  $n$  is the total number of elements.

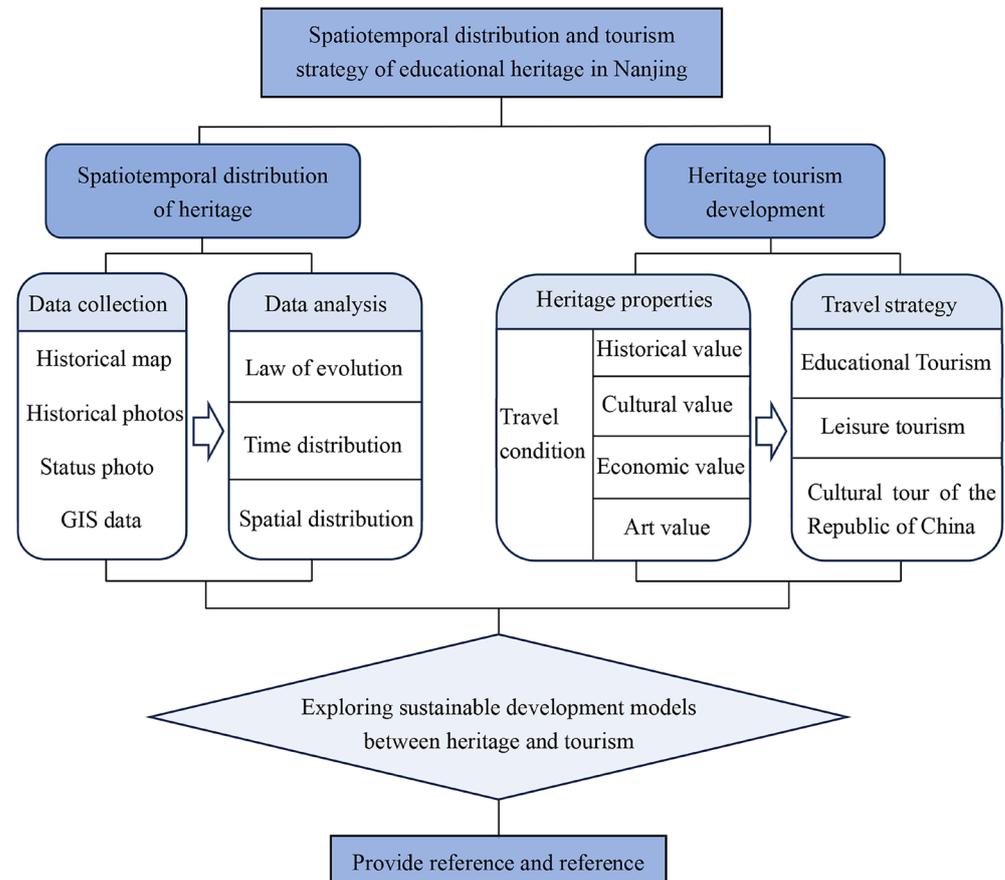
### 3. Buffer tool

The buffer tool was used to analyze the distribution trend of modern educational architectural heritage on the main traffic arteries in Nanjing. According to a buffer width of 0–800 m, we calculated the buffer zone of traffic elements such as roads and water systems. We analyzed the overlapping distribution of the geographical elements of the buffer zone and Nanjing's modern educational heritage, and we generated an analysis map of the percentage of modern heritage sites in the buffer zone with different widths as a percentage of the total. We selected three representative buffer zone widths of 200, 400, and 800 m for analysis and explored the correlation between Nanjing's modern educational architectural heritage and road distribution.

#### 3.2.2. Research Framework

Based on historical research and investigation and surveying and mapping the current situation, we used GIS technology and adopted a combination of qualitative and quantitative methods to obtain the distribution characteristics of modern educational architectural

heritage in Nanjing. Based on the rich educational heritage, in response to government policies, we explored strategies for the integration of heritage and tourism. The research idea is shown in Figure 2.



**Figure 2.** Methodological model.

To study the spatial and temporal distribution of heritage, we needed to collect data first. The collected materials include Nanjing historical maps, archives, education records, construction records, school history data, related works, and field survey statistics. We organized the historical maps and photos and current photos of educational architectural heritage. The geographic coordinate information of all collected educational historical materials was determined through the map system. Excel software (The excel software version used in this paper is Microsoft Excel 2016) was used for statistics and the geographic information database was established via ArcGIS 10.8. Then, in the visual analysis stage, we analyzed the temporal and spatial evolution and distribution characteristics of educational architectural heritage in the historical urban area of Nanjing in stages, and we revealed the temporal distribution, spatial distribution, and evolution rules.

According to the heritage characteristics, the tourism conditions of educational architectural heritage are explored from four aspects: historical value, cultural value, economic value, and artistic value. Then, through the interpretation of the heritage tourism development policies issued by the national government and Nanjing local government, a strategy for the development of modern educational architectural heritage tourism in Nanjing is proposed. The development strategy focuses on study tourism, leisure tourism, and cultural tourism of the Republic of China. Finally, the sustainable development model between modern educational architectural heritage and tourism development in Nanjing is explored, with the purpose of discussing a coupling model of heritage protection and tourism development using the tourism economy as the medium. It can provide a reference

scheme for other types of heritage protection and even domestic and foreign heritage protection and reuse.

#### 4. Results and Discussion

##### 4.1. Census of Educational Architecture Heritage and Analysis of Spatiotemporal Distribution

###### 4.1.1. Census of Educational Architecture Heritage

Influenced by the turbulent social background of modern China, the development of Nanjing's modern educational architecture presents obvious phased characteristics. According to the history of modern education in China and the annals of education in Nanjing, and considering the transformation of the education model in the past 100 years from the late Qing Dynasty to the founding of New China [32,33], we divided the development into four stages: (1) start-up period (1840–1911), (2) prosperous period (1911–1937), (3) stagnant period (1937–1945), and (4) recovery period (1945–1952) of modern educational architecture.

China's modern history began with the first Opium War (1840). In order to save the nation and survive, the government carried out a series of reforms, with education reform at the core. Nanjing established a new type of school accordingly. From 1904 to 1911, the Shanghai–Nanjing and Jinpu Railways were completed. For a while, the west wind became the trend. Therefore, 1840–1911 is set as the initial period of creation. In 1912, Nanjing was established as the capital of the Republic of China, and a large-scale construction period of more than 20 years began. Affected by the war from 1937 to 1945, educational buildings in Nanjing stagnated. After the national government moved back to Nanjing in 1945, the educational buildings were in a recovery period. Until the founding of New China in 1949, many things were waiting to be built. The country's follow-up development relied on the Soviet model for a long time [34]. In 1952, the departments were adjusted. This has continued to be the pattern of today's universities [35], so we chose the period 1945 to 1952 as the fourth stage. However, several historical campuses are protected as a whole as a historical area, and some historical buildings built after 1952 are listed as educational heritage, and this paper includes them in the heritage list.

As of January 2023, according to the research results of Professor Zhou Qi's team at Southeast University over more than 10 years and the educational architectural heritage items announced by the Nanjing Municipal People's Government (Table 2), 117 modern educational architectural heritage buildings have been collected. Except for some educational heritage buildings that have changed their function, most of them have continued as educational buildings. The statistics of modern educational architectural heritage in Nanjing are shown in Figure 3.

**Table 2.** Statistics of modern educational architectural heritage in Nanjing.

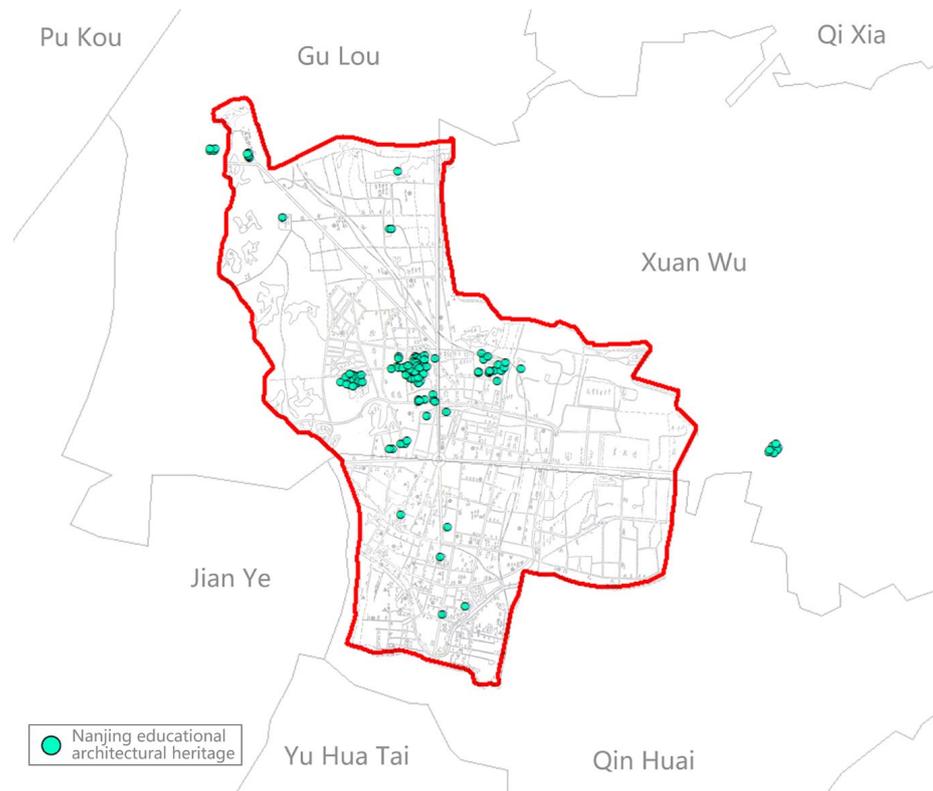
Historical Phases	Heritage Statistics	Heritage Site	Quantity of Heritage Sites	Heritage Address
Initial stage of modern development 1840–1911	9	Former site of Jiangnan Naval Academy	5	No. 346 Zhongshan North Road, Gulou District
		Former site of Jiangnan Lushi School and Mineral School	1	No. 37 Chahar Road, Gulou District
		Former site of Huiwen Private Girls Middle School	1	No. 178 Zhongshan Road, Gulou District
		Former site of bell tower of Jinling Private Middle School	1	No. 169 Zhongshan Road, Gulou District
		Former site of Jinling University School of Medicine	1	No. 321 Zhongshan Road, Gulou District

Table 2. Cont.

Historical Phases	Heritage Statistics	Heritage Site	Quantity of Heritage Sites	Heritage Address
Prosperous period of development 1911–1937	62	Former site of Municipal No. 1 Middle School	1	No. 301 South Zhongshan Road, Qinhuai District
		Former site of Municipal No. 2 Middle School	1	No. 8 Changjiang New Village, Gulou District
		Former site of primary school attached to National Central University	2	No. 2 Sipailou, Xuanwu District
		Former site of National Revolutionary Army Survivors School	8	No. 1 Sifang City, Xuanwu District
		Former Site of National Central University (Sipailou Campus)	13	No. 2 Sipailou, Xuanwu District
		Former Site of gate tower of National Political University of China	1	No. 168 Jianye Road, Qinhuai District
		Former site of teaching building of Yuqun Private Middle School	1	No. 369 Zhonghua Road, Qinhuai District
		Former site of Daosheng Private Middle School	5	No. 408 Zhongshan North Road, Gulou District
		Former site of Jinling University	16	No. 22 Hankou Road, Gulou District
		Former site of Jinling Women’s University	9	No. 122 Ninghai Road, Gulou District
		Former site of Jinling Theological Seminary	2	No. 140 Hanzhong Road, Qinhuai District
		Former site of Jinling Women’s Seminary	3	No. 17 Dajiaoyin Lane, Gulou District
Stagnant period of development 1937–1945	5	Former site of Confucius Temple Primary School	1	No. 22 Zhanyuan Road, Qinhuai District
		Former site of Chung Ying Private Secondary School	1	No. 8 Jiutiao Lane, Qinhuai District
		Former site of National Central University (Sipailou Campus)	3	No. 2 Sipailou, Xuanwu District
Recovery period of development 1945–1952	41	Former site of National Central University (Dingjiaqiao Campus)	2	No. 87 Dingjiaqiao, Gulou District
		Former site of National Central University (Sipailou Campus)	6	No. 2 Sipailou, Xuanwu District
		Former site of Jinling Women’s University	7	No. 122 Ninghai Road, Gulou District
		Former site of Jinling University	26	No. 22 Hankou Road, Gulou District

#### 4.1.2. Spatiotemporal Distribution Analysis of Educational Architectural Heritage

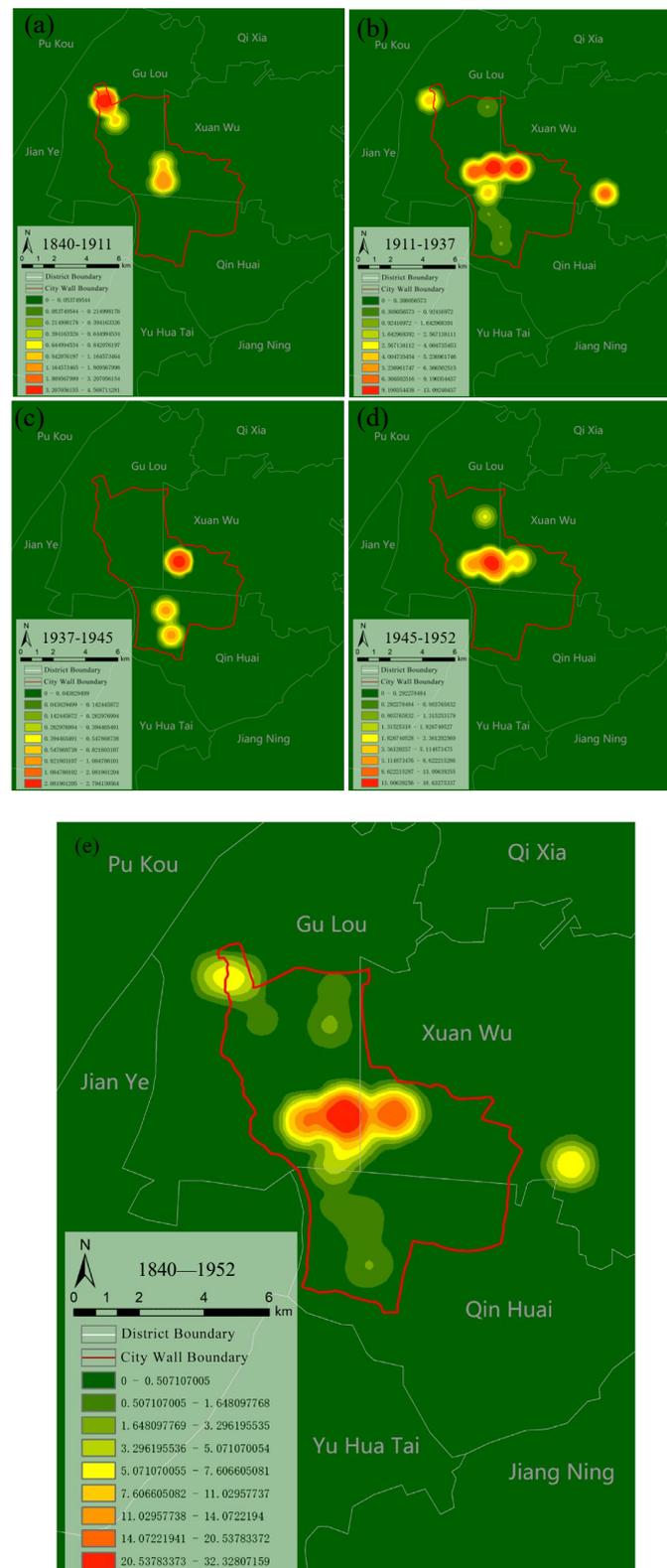
The results of kernel density analysis of educational architectural heritage in various periods using GIS technology (Figure 4) show different characteristics in different historical periods but also reflect certain laws in general. In this figure, the red areas represent heritage intensive areas. From 1840 to the early modern historical period, Nanjing’s educational architectural heritage was concentrated in three areas: the Gulou, Xuanwu, and Qinhuai Districts. These were part of the core areas of Nanjing’s economy at that time [36], and there were few educational architectural relics in other areas. From the distribution map of schools from 1911 to 1937, we can see that modern educational buildings began to break through the city wall and develop outwards; after 1945, they broke through the city walls and spread outwards, presenting a general trend from centralized to uniform distribution.



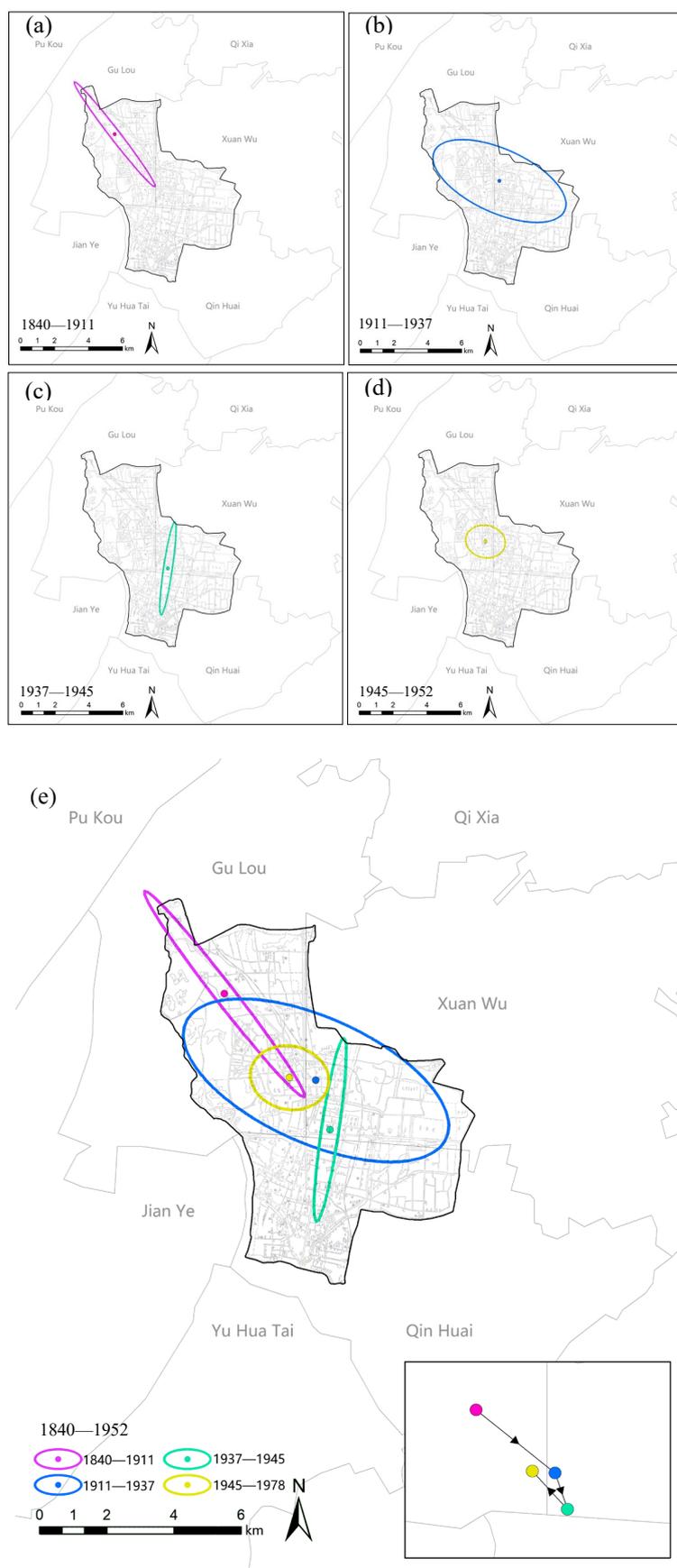
**Figure 3.** GIS database based on Nanjing educational architectural heritage census.

The standard deviation ellipse and mean center analysis were used to obtain the spatial distribution of the center of gravity and standard deviation ellipse of educational heritage in each period, respectively (Figure 5). In general, the center of gravity of the school heritage distribution in the four stages is located within the old city of Nanjing, close to current traffic arteries such as Zhongshan North Road, Zhongshan Road, and Zhongshan East Road. In terms of the average center migration trajectory in the four periods, the average center of school heritage shows a general trend of shifting from northwest to southeast, then southeast, and finally northwest.

According to parameters such as the flattening, area, major axis length, and minor axis length of the standard deviation ellipse (Table 3), the spatial distributions of school heritage in the four periods can be classified into three types of ellipses. The first type covers the periods 1840–1911 and 1937–1945. This type of standard deviation ellipse has large oblateness and a small area, and the length of the major axis is much greater than the length of the minor axis. It shows that the distribution of school heritage in these two periods has the characteristics of a linear distribution along Zhongshan North Road and Zhongshan Road, corresponding to the kernel density map. The second type covers the period 1911 to 1937. The oblateness of this type of standard deviation ellipse is 0.56, and the area, major axis length, and minor axis length are much larger than those for the previous two periods, which shows that the distribution of school heritage in this period is large. This period was part of a construction boom of school buildings. The third type covers the period 1945 to 1952. The flatness of this type of standard deviation ellipse is small, the lengths of the major axis and minor axis are close, and the area of the ellipse is small, indicating a high concentration of school heritage in this period.



**Figure 4.** (a) Kernel density distribution of modern educational architectural heritage in Nanjing built between 1840 and 1911; (b) kernel density distribution of modern educational architectural heritage in Nanjing built between 1911 and 1937; (c) kernel density distribution of modern educational architectural heritage in Nanjing built between 1937 and 1945; (d) kernel density distribution of modern educational architectural heritage in Nanjing built between 1945 and 1952; (e) kernel density distribution of modern educational architectural heritage in Nanjing built between 1840 and 1952.



**Figure 5.** (a) Center of gravity and standard deviation ellipse of spatial distribution of modern school sites in Nanjing built between 1840 and 1911; (b) center of gravity and standard deviation ellipse of

spatial distribution of modern school sites in Nanjing built between 1911 and 1937; (c) center of gravity and standard deviation ellipse of spatial distribution of modern school sites in Nanjing built between 1937 and 1945; (d) center of gravity and standard deviation ellipse of spatial distribution of modern school sites in Nanjing built between 1945 and 1952; (e) center of gravity and standard deviation ellipse of spatial distribution of modern school sites in Nanjing built between 1840 and 1952.

**Table 3.** Spatial distribution centroid and standard deviation ellipse parameters by period.

Historic Period	Areal Coordinates	Directional Angle	Long Axis (km)	Short Axis (km)	Length (km)	Oblateness	Area (km <sup>2</sup> )	Moving Direction	Moving Distance (km)
1840–1911	118.757° E 32.077° N	137.66°	7.68	0.58	15.49	0.92	3.48		
1911–1937	118.782° E 32.057° N	109.58°	8.37	3.71	19.69	0.56	24.38	Southeast	3.71
1937–1945	118.785° E 32.045° N	9.89°	5.48	0.51	11.10	0.91	2.19	Southeast	1.52
1945–1978	118.775° E 32.057° N	96.63°	2.32	1.87	6.60	0.19	3.41	Northwest	1.95

#### 4.1.3. Cause Analysis of Spatiotemporal Distribution of Educational Architecture Heritage

The temporal and spatial evolution of modern educational buildings in Nanjing are closely related to the historical environment. After the Opium War in 1840, the Chinese government carried out a series of educational reforms and established a series of new schools. In 1899, the opening of Nanjing as a port and the construction of urban infrastructure directly affected the distribution of new schools. They were concentrated in Xiaguan and set up along Ningma Road along the Yangtze River. At the same time, Western churches began to establish missionary schools in Nanjing. These missionary schools used transplanted Western architectural forms, were mainly influenced by missionary activities, and were concentrated near the Drum Tower in the city. They were set up near churches and missionary hospitals, forming a religious cultural circle. Therefore, the educational heritage of this period was concentrated in Xiaguan and the Drum Tower in the north of the city.

In 1912, Nanjing was established as the capital of the Republic of China, and the relatively stable regime provided certain financial support for educational development. The number of educational buildings increased on the original basis, and the types of educational buildings were also generally divided. The Capital Plan formulated by the government in 1929 guided the distribution of primary and secondary schools. Taking this as a node, the implementation of the Capital Plan directly changed the distribution mode of primary and secondary schools concentrated in the city and south of the city. From then on, Nanjing's primary and secondary schools began to be reasonably set according to the population density and the proportion of school-age children, and they were evenly distributed throughout the city. During the "Golden Decade", due to the rapid development of Nanjing's traffic, economy, and population, the location of schools was no longer limited to within the city walls, and some colleges and universities were built outside the city walls. As church-run schools were gradually accepted by the people, they developed from the center of the city to Xiaguan in the north and to the south and west of the city due to the expanded scope of missionary activities.

From 1937 to 1945, educational buildings in Nanjing were stagnant. Before the fall of Nanjing, most local and church schools moved to Chongqing. Overall school construction declined, and school buildings were mainly repaired, with a few expansions and few new constructions.

From 1945 to 1952, Nanjing's educational buildings entered a recovery period, and a large number of relocated schools moved back to the city. After the war, the number increased sharply and school construction proceeded rapidly, but school buildings mainly

addressed actual needs. After the founding of New China in 1949, the universities adjusted in 1952 and built some new buildings, mainly distributed in the north and the middle of the city, and they also became important parts of the educational heritage.

To sum up, in terms of time, educational architectural heritage developed from north to south in the city. In terms of space, it was mainly distributed along important traffic arteries, such as Zhongshan North Road, Zhongshan Road, Zhongshan South Road, and Zhongyang Road, and was concentrated in the Gulou–Qingliang Mountain and Beijing East Road Historic District, presenting a spatial distribution pattern of “two belts and three cores”, with higher density in the mountain area, followed by the historic district. Zhongshan Road connects most of the educational architectural heritage. According to the Nanjing Land and Space Master Plan (2021–2035) Draft Announcement [37] and Nanjing Historical and Cultural City Protection Regulations [38], this axis of the Republic of China is of great historical value and requires conservative development. Based on this, we analyzed the buffer zone of the remaining educational architectural heritage, found a correlation between heritage and traffic arteries, and created a research and study travel path with historical and educational significance.

#### 4.2. *Traveling through Culture: Educational Heritage Tourism Strategies*

##### 4.2.1. Educational Heritage Tourism Development Policy

Nanjing’s 13th Five-Year Tourism Industry Development Plan [39] pointed out that by 2020, China would become a well-off tourism country, the number of domestic tourists would reach 6.7 billion, the number of inbound international tourists would reach 150 million, and the total tourism revenue would exceed CNY 7 trillion. The vigorous development of the national tourism industry was projected to bring broad market space for the tourism industry of Nanjing. Second, favorable policies have promoted the vitality of development. The Tourism Law of the People’s Republic of China [40], the National Tourism and Leisure Outline (2013–2020), and other policy documents were released in a concentrated manner, optimizing the development environment of the tourism industry. They provide a policy guarantee for the city’s tourism industry to accelerate supply-side reform and achieve sustainable growth. In addition, the development of cultural tourism will enhance the pedigree of tourism products that Nanjing will focus on developing during the 13th Five-Year Plan period (Table 4). The city clearly proposes to use the rich educational resources of the ancient city and the culture of the Republic of China to develop tourism. This will provide direct policy guidance for modern educational architectural heritage tourism in Nanjing. Therefore, it is urgent to develop educational heritage tourism.

Educational heritage tourism is a product of the combination of cultural and characteristic tourism and is cultural heritage tourism with specific themes. From the list of tourism products in Table 4, it can be seen that educational architectural heritage tourism belongs to the main category of cultural tourism and characteristic experience products and has development potential in four subcategories: cultural heritage tourism; cultural tourism of the Republic of China; science, education, cultural, and museum tourism; and research tourism.

Nanjing’s 14th Five-Year Plan for Cultural and Tourism Development [41] pointed out that it is necessary to carry out the following: Launch cultural heritage tours, cultural museums, and science and education tours, and create demonstration enterprises and projects. Change the previous situation of the separation of culture and tourism-related laws and regulations. In accordance with the general idea of integrating as appropriate, integrating as much as possible, using culture to shape tourism and tourism to promote culture, promote the continuous improvement of the cultural and tourism legal system. Give full play to the role of government policies and keep up with the mainstream. Promote the sound development of educational architectural heritage tourism in Nanjing.

**Table 4.** Pedigree of tourism products mainly developed in Nanjing during 13th Five-Year Plan period.

Main Tourism Product Categories	Tourism Product Subcategories	Development Direction
Cultural tourism	Cultural heritage tourism	By exploring the cultural connotation of Nanjing and creating a variety of themed cultural products, people will be able to feel the rich cultural atmosphere.
	Republic of China cultural tour	Relics of the Republic of China are connected in series to form tourism products such as relics tours and celebrity exploration tours.
	Science, education, and cultural tourism	Resources of Nanjing cultural museum science and technology venues are integrated to develop science, education, and cultural tourism products and to realize the linkage of venues.
	Red educational tourism	Take revolutionary memorial sites, monuments, and the revolutionary spirit they carry as the main body for developing red educational tourism products.
Featured experience	Health care tourism	Take advantage of the growing health care market and, based on the excellent ecological environment, develop Nanjing's characteristic health care tourism industry.
	Yacht cruise tourism	Take advantage of Nanjing's abundant water resources to develop cruise and yacht tourism products for mid- to high-end markets.
	Study tourism	Rely on Nanjing's rich natural and human, museum, and educational resources to develop research and travel products and establish a research and travel base.

#### 4.2.2. Educational Heritage Tourism Value

The penetration and distribution relationship of educational architectural heritage in urban space has rarely been studied, and quantitative GIS analysis can be used to reveal the advantages and disadvantages of the current space for protective reuse. Then, the spatial performance of the entire educational architectural heritage can be optimized, and a novel tourism optimization strategy can be proposed. At present, in addition to its high use value, artistic aesthetic value, and emotional value, educational architectural heritage also has value in four areas of tourism development.

**Historical value:** From the new schools in the late Qing Dynasty to modern times, reforms have advanced the development of China's educational system as a historical witness. Educational architectural heritage still has value for historical research, providing a basis for people to understand the social background and characteristics of the times and the urban development of a specific period.

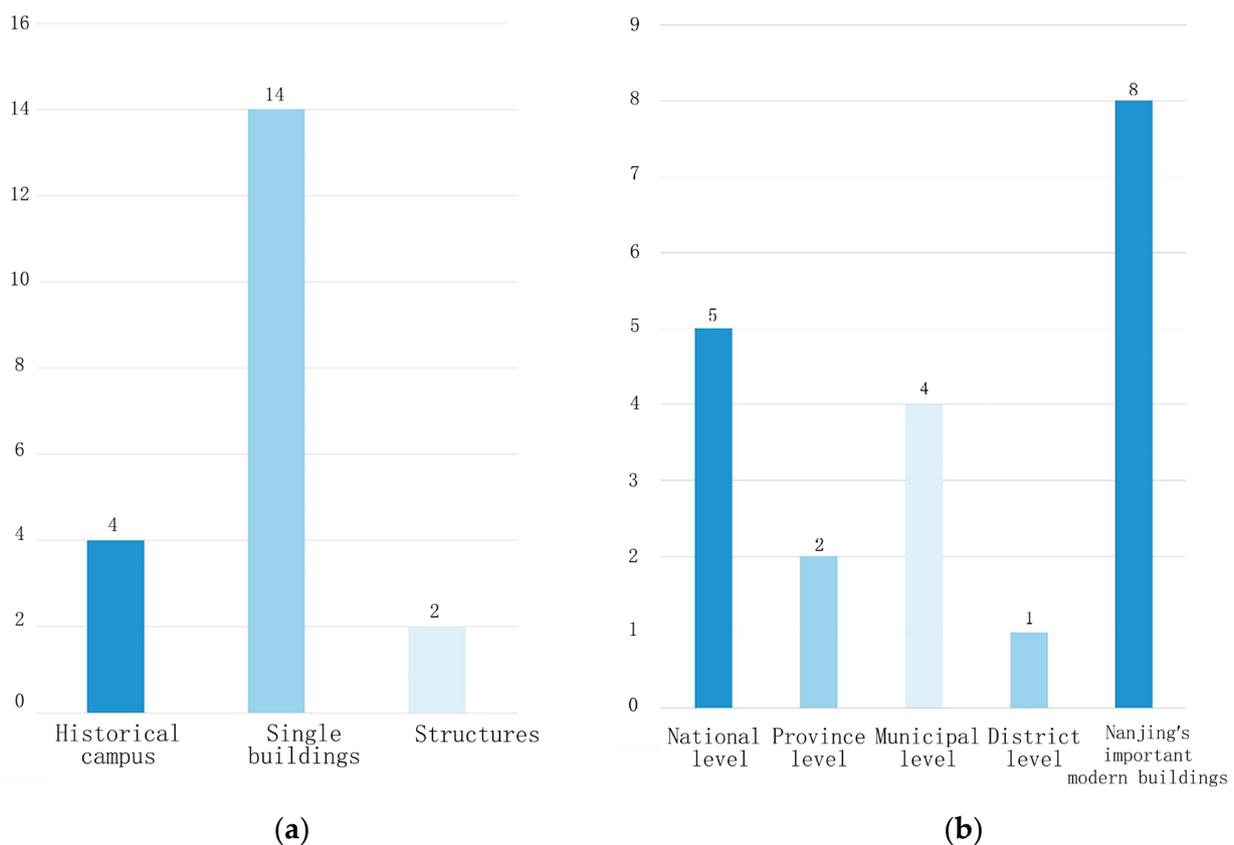
**Cultural value:** The development of educational heritage tourism should first ensure that the original style and architecture are not destroyed. The original educational space represents historical memory, on the one hand, and the historical origin of Nanjing as the capital of education in China, on the other hand. This is the unique cultural background of modern Nanjing, which has established a strong cultural atmosphere today, and is a characteristic chapter of a famous historical and cultural city.

**Economic value:** For educational architectural heritage tourism, long-term value-oriented economic feedback should be valued more than short-term benefits. Short-term economic benefits include income from tickets for attractions, museums, and exhibition halls and from catering services in tourist parks. Attaining long-term income is determined via market trends, which reflects actual and potential customer needs and is specifically manifested in the free advertisements that can establish cultural brands and market orientation obtained through evaluations by tourists. In the long run, developing educational architectural heritage tourism can drive the economic development of the surrounding educational architectural heritage, and the regions of the whole city will be linked. This will promote the development of tourism in the whole city, protecting the heritage will promote tourism development, and tourism development will revitalize the economy and feed back sustainable benefits.

**Artistic value:** As witnesses to the reform and development of education, these educational architectural heritage sites record human creation, aesthetic taste, and the typical styles of a specific era, including memory, emotion, education, etc. Nanjing schools in modern times have gradually evolved from Chinese-style architectural forms and have experienced the transformation of combining Chinese and Western styles.

Due to the contextual inheritance effect of educational architectural heritage, after being repaired and updated, it can promote current urban development and potentially tourism development. The type and spatial distribution are important factors affecting the protection and reuse of heritage. The utilization of different educational buildings varies greatly.

According to statistics, Nanjing's modern educational architectural heritage includes 20 historical campuses, 18 of which are protected, and only 2 are not included in the Chinese government's cultural relics protection list. According to the statistics of heritage status Figure 6a: 4 of them exist in the form of historical campus areas, 14 educational heritages exist in the form of single buildings, and 2 educational heritages only have school gates and other structures left. According to the statistics of heritage status levels in Figure 6b: there are 5 national-level cultural relics protection units and historical areas, 2 provincial-level cultural relics protection units, 4 municipal-level cultural relics protection units, and 1 district-level cultural relics protection unit. There are also 8 important modern buildings.



**Figure 6.** (a) Status quo of protection and reuse and (b) statistical map of types of educational architectural heritage reuse in Nanjing.

Based on on-site research and historical data, Nanjing's educational architectural heritage can be divided into three categories: campus type, single building type, and structure type.

## 1. Historical Campus

A historical campus appears in the form of one parcel and has complete functions. It generally includes buildings such as teaching and laboratory buildings; auxiliary buildings such as libraries and auditoriums; and residential buildings such as student and teacher dormitories. Campuses generally occupy several or even dozens of hectares and include many types of buildings. They have the highest heritage protection value and are usually designated as national protection units (Figure 7).



**Figure 7.** Ginling College campus.

This type of campus architectural heritage is mainly distributed in the Gulou District. Currently, there are the Gulou and Qingliangshan Historic Districts. The Nanjing municipal government has formulated a protection plan for the historical districts from Gulou District to Qingliangshan Historic District and Beijing East Road. A boundary line was delineated, and three major areas were created: the National Central University, Jinling University, and Jinling Women's University Historical Areas. This is closely related to the type of educational building and the scale of the school. Among them, university-type buildings are relatively well preserved and are mainly concentrated in the vicinity of Gulou District in the central city. At present, they continue to perform their primary function and are still used as a university campus. The buildings are relatively well preserved.

## 2. Single Building

Educational architectural heritage in the form of a single building is the most common, such as the remains of a certain teaching or office building, student dormitory, or residence. Under normal circumstances, the area of a building is generally several hundred square meters, so its value is generally lower than that of an entire campus, but it is generally a municipal cultural relic protection unit (Figure 8).



**Figure 8.** (a) Former library of Nanjing Daosheng Middle School; (b) former bell tower of Jinling Middle School; (c) teaching building of Yuqun Middle School; (d) former office building of Huiwen Girls Middle School.

### 3. Structure

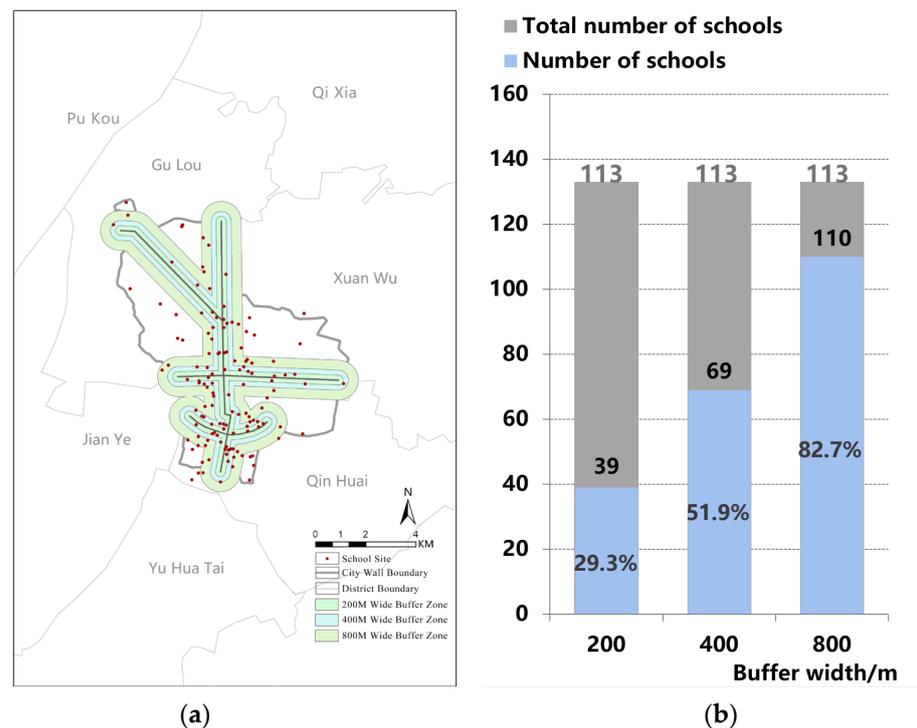
There are mainly two structures: the gates of the National Central Political University and the Jiangnan Naval Academy, which are provincial and municipal cultural relic protection units, respectively. Such structures are mainly distributed along the roads in the central area of the city; as tourist attractions, they maintain their vitality by maintaining their existing function as heritage landscape elements (Figure 9).



**Figure 9.** (a) Gate of former Jiangnan Naval Academy; (b) gate of former Chengchi University.

#### 4.2.3. Educational Heritage Tourism Strategies

Based on the above research, the spatial distribution of modern educational architectural heritage in Nanjing is related to the main traffic roads. We used a spatial connection tool to calculate the number of educational buildings within each buffer width, and the results are shown in Figure 10. There are 39 educational buildings within 200 m of the main road (accounting for 29.3% of the total), 69 educational buildings within 400 m of the main road (accounting for 51.9% of the total), and 110 educational buildings within 800 m of the main road (82.7% of the total). Correspondingly, the spatial distribution of educational architectural heritage is closely related to the main roads in Nanjing: the closer to the main roads, the denser the distribution.



**Figure 10.** (a) Map of buffer zones for school sites and (b) cumulative percentage of school sites in buffer zones of different widths in Nanjing.

Based on the analysis of core density and buffer zones above, we propose a tourism route of “two belts and three cores” for the educational architectural heritage of the Republic of China. The two belts consist of two important traffic arteries, including Zhongshan North Road, Zhongshan Road, Zhongshan South Road, and Central Road. These can be used as a special form of protection of the historical axis in Nanjing, presented as a subordinate of the axis of the Republic of China, enriching the characteristic supplements of the education sector of the Republic of China. The three cores are concentrated in the Drum Tower–Qingliang Mountain area and the historic district of Beijing East Road. This area already has a relatively mature business format. Through development, its influence can be expanded and the educational architectural heritage of other areas can be linked to form a systematic tourist route.

Based on market demand, we propose two modes combining cloud tourism and on-site tourism.

Cloud tourism is in the form of digital museums, digital exhibition halls, and other virtual means. In recent years, frequent natural disasters, sudden public health incidents, harsh and necessary environmental factors, and other uncertain factors around the world have interfered with the sustainable development of the tourism industry. The development of educational architectural heritage tourism has improved resilience to various risks.

Therefore, the development of educational architectural heritage tourism under the “two belts and three cores” model needs to use digital means to strengthen its linkage, integrity, and ability to resist risks. Scenic spots can be digitized to form a tourism community, so that tourists can visit them anytime and anywhere. This online cloud tourism operation method would enhance the attractiveness of educational architectural heritage.

On-site tourism combines an on-site tourism model with smart services. By viewing displays of the history of modern educational development, experiencing and visiting educational architectural heritage sites, historical campuses, cultural centers, educational museums, etc., tourists can feel and experience the strong cultural and educational atmosphere of the ancient city. By developing the two modes, we can create a cultural brand, link other scenic spots, and develop a unique tourist destination.

Based on the characteristics of educational architectural heritage, we propose the following tourism strategies:

1. Develop research tourism for the youth market.

The role of teenagers as tourists is often ignored, although research and study travel paths have been developed for teenagers to enrich their extracurricular life. Nanjing has a profound history and culture, and its educational architectural heritage is extremely valuable and reflects the difficult process of providing education and running schools, which has important educational significance. This kind of heritage with educational and learning significance has a cultural status that cannot be ignored in the history of education and is an important cultural relic. Therefore, such sites should be used as educational museums or heritage tourism bases to form a new experience of educational architectural heritage tourism integrating research, learning, and tourism. In addition, school history museums could link up with major education museums to form a complete tourism product to better disseminate educational heritage culture. Secondly, the combination of educational architectural heritage and cultural tourism could activate the cultural potential and enrich the reuse value of educational architectural heritage. With the help of research trips, a variety of combined educational architectural heritage and tourism products could be developed to help youth groups better learn history and enrich the utilization value of educational architectural heritage.

2. Develop experiential and leisure tourism for the domestic market.

Simple sightseeing tourism can no longer meet the increasing tourism demand. By forming regional linkages among urban areas to expand the tourism market, we could provide educational heritage leisure tourism or shopping tours for residents of local and surrounding cities to experience the peaceful student life and beautiful campus scenery.

3. Highlight Chinese traditional culture for the international market.

Nanjing’s educational heritage includes a number of church schools founded by the British and American churches, and there are some former residences of Western missionaries on university campuses. These educational heritage sites have great emotional and artistic value. They have witnessed the blending of Chinese and Western cultures and recorded the development of British and American churches in Nanjing, and they possess international appeal. Therefore, they can be used to build tourist areas of church school ruins, develop an international market, establish a digital museum of church schools, show the history of Western church schools in Nanjing, and tell the stories of representative figures at these schools. In addition, the style and characteristics of the architectural heritage left over from church schools can be exhibited for educational purposes.

4. Organize activities in conjunction with International Heritage Conservation Day, Cultural and Natural Heritage Day, Reading Day, major school celebrations, etc.

Tourism and holidays are naturally related, and holding special activities on holidays can attract tourists and stimulate business and economic development. For example, based on the tourism theme of “Zheng He’s Voyages to the Western Seas”, Nanjing organized various themed activities in Longjiang Treasure Relics Park on China Navigation Day. Developing

educational architectural heritage sites for tourism can also include relevant festivals and special programs to attract tourists. In addition, the influence can be expanded by using a method of joint online and offline publicity, which could include establishing an official “two belts and three cores” tourism website, a WeChat applet, and an app for modern educational architectural heritage in Nanjing. New tourism themes on relevant festivals could be introduced and promoted.

#### 4.2.4. Explore the Sustainable Relationship between Educational Heritage Protection and Tourism Development

Tourism is recognized as a tool for achieving the United Nations Sustainable Development Goals (SDGs) to eradicate poverty, protect the environment, and promote social inclusion [42,43]. The sustainability of heritage tourism is an extension of the concept of sustainability. One of the bases for the development of educational architectural heritage cultural tourism proposed in this paper is cultural sustainability, which is an important part of the sustainable development of cultural tourism. In “Transforming Our World: the 2030 Agenda for Sustainable Development”, the United Nations recognizes the role of culture in promoting sustainable development, as both a driver and an enabler [44,45]. As a driving force, culture can be seen as a part of achieving sustainable development. As an enabler, industrial development must respond to and coordinate with the cultural background and particularity of a region and adapt to local conditions. This can not only make the implementation of development strategies more effective but also use the value of culture to improve people’s living environment, while bringing opportunities for regional economic development and employment.

Therefore, heritage tourism based on the principle of sustainability must be culturally appropriate, economically feasible, and environmentally sensitive, and a balance should be struck between heritage protection, economic development, and environmental protection to achieve sustainable development goals.

The Chinese government invests a lot of money in the protection of educational heritage every year, and this kind of one-way support has resulted in a huge waste of funds. The educational architectural heritage tourism strategy proposed in this paper could be used to build a sustainable heritage protection and reuse model. Building educational architectural heritage into scenic spots and tourist routes could enrich its value and bring economic benefits. The economic value it creates could be invested in its own protection, forming a virtuous circle and promoting sustainable development.

The sustainable protection of architectural heritage can realize the harmonious development, close integration, and continuation of the functions of historical culture in modern cities and maximize the intrinsic value. This paper puts forward the protection strategy of “two belts and three cores” for Nanjing’s modern educational architectural heritage and constructs a strategy for modern educational architectural heritage tourism. The evolution and development of modern education in Nanjing represents the evolution of modern education in China, and the reuse and protection of modern educational architectural heritage has greatly stimulated its value. Especially as a part of tourism development, it can create great educational and economic value, allowing people to continue expressing their feelings for architectural heritage. The income generated can be used to feed back into the expenditures of heritage protection, to form a virtuous and sustainable cycle. In addition, the development of architectural heritage as a tourism product will drive regional economic development, create a better living environment for community people, and provide more employment opportunities. This is in line with the United Nations Sustainable Development Goals (SDGS), which address poverty, hunger, and decent work.

## 5. Conclusions

Based on the authors’ research on Nanjing’s modern educational architecture and data from a census of educational architectural heritage, in this study, we summarized the development characteristics and constructed a GIS database. Based on the database,

kernel density, standard deviation ellipse, and buffer zone analyses were carried out to study the spatiotemporal distribution characteristics of educational heritage in Nanjing. The results show the following: (1) Based on the specific social background at that time, the development of modern educational buildings in Nanjing showed obvious stage characteristics, which can be roughly divided into four periods: the initial period (1840–1911), the prosperous development period (1911–1937), the period of stagnation (1937–1945), and the period of recovery (1945–1952). Correspondingly, the educational heritage was mostly established in the period of development and prosperity. In terms of time, the educational heritage presents a north-to-south distribution pattern. In terms of space, the educational heritage is distributed along important traffic arteries, such as Zhongshan North Road, Zhongshan Road, Zhongshan South Road, and Zhongyang Road, and is concentrated in the Gulou–Qingliang Mountain area and Beijing East Road Historic District, presenting a spatial distribution pattern of “two belts and three cores”.

This paper is based on the heritage tourism policy proposed by the government. For the first time, positioning the ancient city as a road of culture, education, research, and study is proposed, and a multilevel, multidimensional point–axis–plane tourism system is constructed to tap into the value of tourism, prospectively create cloud and on-site tourism models, and propose feasible development strategies. Finally, the paper explores sustainable development patterns between heritage and tourism, which involve expanding the tourism market through regional linkage, using the tourism economy to feed back into the restoration of heritage, realizing the benign and sustainable development of cultural heritage protection and the tourism industry and providing a reference for educational heritage tourism in other cities.

In the future, the sustainable relationship between Nanjing’s educational heritage and tourism development can be analyzed from other perspectives to explore a new sustainable tourism development model. In addition, if other types of historical heritage are to be preserved and developed in the form of cultural tourism, more specific relational models need to be built.

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