Article

Social-Spatial Accessibility to Urban Educational Resources under the School District System: A Case Study of Public Primary Schools in Nanjing, China

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Abstract: Recent discussions on the spatial distribution of educational resources center on exploring the social-spatial equity of the allocation of educational resources in the city. Following the research about spatial accessibility of urban educational resources, and based on the data about public primary school districts and residential districts in Nanjing, China, we propose a social-spatial accessibility computing framework to measure different degrees of accessibility to different public primary schools across geographic, opportunity, and economic dimensions. Results show that: (1) the geographic accessibility to schools in the inner-city is superior to those in the outer-city, but the spatial differences are rapidly shrinking as schools are being incorporated in the inner-city and built in the outer-city; (2) the opportunity accessibility to schools in the inner-city is inferior to those in the outer-city, and the access to the educational resources in the inner-city, especially high-quality education resources, becomes more scarce, due to the demolition in the inner-city and the construction in the outer-city; (3) economic accessibility is associated with the grade of the school, which, in the top school district, is the minimum, while there is a large decline in economic accessibility, with the overall soaring housing price in Nanjing. In other words, family background differences appear to have a significant influence on accessibility to high-quality educational resources (HQER). As a result, misallocation of educational resources, especially HQER, restrict social mobility and further exacerbate urban socio-spatial differentiation.

Keywords: school district; educational equity; social-spatial accessibility; jiaoyufication; Nanjing; China

1. Introduction

Since education is thought to be an important means for promoting social mobility [1], equity in allocation of educational resources is an academic issue of continuous concern in the field of geography and sociology in China [2–8]. The socioeconomic differences between regions, urban and rural, and schools are intertwined with a misallocation of educational resources. As a result, urban geographers pay more attention to the unbalanced layout and spatial optimization of educational resources in cities [9–11]. Especially, they are mainly concerned with the spatial accessibility of educational resources [12–14] and reveal the spatial equilibrium of resource allocation by comparing the matching degree of the supply of educational resources and the demand in the service range. These studies revealed the differences in accessibility to educational facilities in several types of cities, including kindergarten [15], primary and middle schools [16,17], and high schools [9,14,18]. Methods used in these studies

include Geographic Information System (GIS) spatial analysis technology, minimum distance, or the shortest time method [14], the two-step floating catchment area method [19], the potential model [20], space-time accessibility [21], and more. Based on the results of the calculations, scholars evaluate the spatial allocation of educational resources in cities.

However, these quantitative studies overlooked the importance of the social attributes of accessibility to urban educational resources and the influences of different social attributes on obtaining educational resources. Beyond that, although these studies revealed many problems caused by the misallocation of urban educational resources, the formation mechanism of the misallocation and the different accessibility to urban educational resources that come along with it were not adequately explained. Thus, following the research about spatial accessibility of urban educational resources, and based on the data about public primary school districts and house prices in Nanjing, China, we propose a computing framework to measure different accessibility to different public primary schools across social and spatial dimensions. Based on this result, we discuss the mechanism of social-spatial lock-in of high-quality educational resources (HQER) and its effects.

2. Educational Reform and Social Stratification: Uneven Social-Spatial Accessibility to Urban Educational Resources

2.1. Educational Reform, School District, and Uneven Educational Resources in Urban Areas

Neoliberalism education reform since the mid-1980s gave more autonomy and resources to schools and added more options for students in China. Taking the basic education stage as an example, the reform decentralized the financial management and administration of education from central to local governments and allowed the non-state sector, including private and overseas sectors, to provide formal basic education [22,23]. Meanwhile, in the premise of ensuring enrollment policy of public school consistency, the Chinese government gives more flexibility for the non-public school. The Chinese government hopes that these reforms can reduce the financial burden of central and local governments in delivering basic education, increase the resources of the school, give students more choices and, consequently, realize a balance between efficiency and equity [24,25]. However, in actuality, the situation is not so optimistic.

Aged children can be enrolled in a nearby public school based on their *hukou*, which is combined with the housing property, to receive nine years of compulsory education (from primary to junior secondary education). This institution was enacted to ensure the fairness of education. However, children had been given an equal opportunity to be educated rather than given an equal quality of education. There are two reasons for this: Firstly, schools do not obtain equal financial or other support from the local government, with fewer, yet better equipped (key and top) schools are supported by higher government than normal schools [24]. Regional disparities between rural and urban or coastal and inland are even more considerable [26]. Secondly, students may be allowed to enter another district school by paying a school choice fee [27,28]. With the housing and *hukou* reform and property market booming, less wealthy parents can immediately migrate their children's *hukou* to key and top school districts by buying a school district house (*xuequ* house) [29].

All these changes have created an actual room for the rent-seeking behavior of parents [30,31]. As a result, we have every reason to believe that the neoliberalism education reform breaks the educational inequality caused by simplex institutional structure and political selection criteria [32,33], but leads to a new educational inequality and segregation. Consequently, the accessibility in the traditional study cannot exactly reflect the unfairness in education caused by the quality of schools. Thus, although the school district system has reduced the paths to school enrollment, social and economic capital has become the main method for social groups to compete for education resources. Additionally, the accessibility in the traditional study cannot exactly express the difference and the fairness in the allocation of HQER caused by the difference in the affordability of housing [34].

2.2. Social-Spatial Accessibility to Urban Educational Resources under the School District System

As mentioned above, there is a significant correlation between the acquisition of educational resources and the inter-generational and intra-generational social mobility of class groups [35,36]. The unbalanced distribution of educational resources is very likely to sharpen social stratification and social-spatial imbalance. The opportunity to gain basic education is affected by the internal attributes of a class group (such as economic, cultural, political, and social capital), as well as the difference in external institutions, such as household registration, work unit, and school district [37], on the one hand. Conversely, the quality of compulsory education plays a significant role in subsequent access to higher education, career choice ability, and social identity recognition [7,8], which then creates intergenerational duplication and transmission of educational quality, income level, and social class relations, weakening social vertical mobility, and even leading to class solidification [38]. Thus, there is an intra-generational coupling and inter-generational locking relationship between educational differentiation and social stratification. The fair allocation of urban educational resources has a deep role in slowing down social differentiation and promoting social mobility; in other words, it is worth the full concern of scholars.

Indeed, research on the fairness of urban public service in developed countries has gone through three stages: spatial balance of facility distribution, fairness of opportunity availability, and social equity of resource allocation [39–41]. Both spatial accessibility and social accessibility should be considered in measuring urban educational resource accessibility in China. The former refers to the difficulties in starting from the beginning, overcoming various obstacles, and reaching the destination [42]; the latter refers to the opportunities or cost of initially gaining educational resources, or selecting them later. Thereby, this paper proposes social-spatial accessibility to extend the concept of spatial accessibility and describe the comprehensive difficulties of families subject to acquiring educational resources in a school district. Specifically, it includes three parts: (1) geographic accessibility, judging the distance of residents reaching educational services from a space-time view; (2) opportunity availability, judging the probability of residents obtaining educational services from the perspective of resource allocation; and (3) economic affordability, judging the economic cost to residents obtaining educational services from the perspective of resource selection. Through researching social-spatial accessibility of education resources in a city, the authors can multi-dimensionally investigate and compare the difficulties in obtaining educational resources of different grades and make a perspective analysis on the allocation mode and different mechanisms to gain urban educational resources of high-quality in the social space. Thus, the authors can obtain a more comprehensive and objective judgment on urban education resource allocation under the school district system.

Education equity and its sustainable development should focus on promoting the fairness of educational opportunities and quality in the new era. However, the fairness of educational resource allocation is embedded in the school district system and school district space from the perspective of social space accessibility. This paper analyses the difference in social-spatial accessibility of education resources and its evolution, taking the public primary school in Nanjing as the research object and the school district as a spatial unit. Particularly, it analyzes the difficulties for different social groups to obtain HQER. Moreover, it analyzes the mechanism of the locking effects of the different urban educational resources and attempts to detect the stratified differentiation and residential differentiation caused by the imbalanced educational resources, which are also the social-spatial problems that affect the sustainable development of society.

3. Methodology and Data

3.1. Data Features

According to the data provided by the Nanjing Education Bureau, for the study area, the number of public primary schools (school districts) has decreased from 154 to 143 during 2008–2018. The average area of a single school district has increased from 1.91 km^2 to 2.06 km^2, expanding gradually from the

inner-city to the outer-city, with Xinjiekou as the center (Figure 1a,b). There exist differences in the quality of primary education. Consequently, according to the ratio of students admitted by Nanjing Foreign Language School (there is no official ranking for primary schools in Nanjing. People usually take the number of students admitted by the junior high school of the Nanjing Foreign Language School as the basis for ranking primary schools. Considering the differences in the size of primary schools, the authors evaluate the quality and classification of primary schools by the data of their admission rates from the Nanjing Foreign Language School.), public primary schools in Nanjing are divided into four grades: top-level (admission rate > 10%), high-level (2–10%), moderate-level (0.5–2%), and general (<0.5%) (Table 1). Comparing data between 2008 and 2018, the authors find that the spatial pattern of the school grade has changed little and high-grade primary schools are mainly distributed in Gulou District and Xuanwu District (Figure 1c,d). According to the information provided by the China House Price Market platform, residential communities in the study area have increased from 2058 to 2527. Like that of primary schools, their distribution pattern is clustered in the inner-city and dispersed in the outer-city, while the newly-added residential communities are mainly distributed in the outer areas (Figure 1e,f).
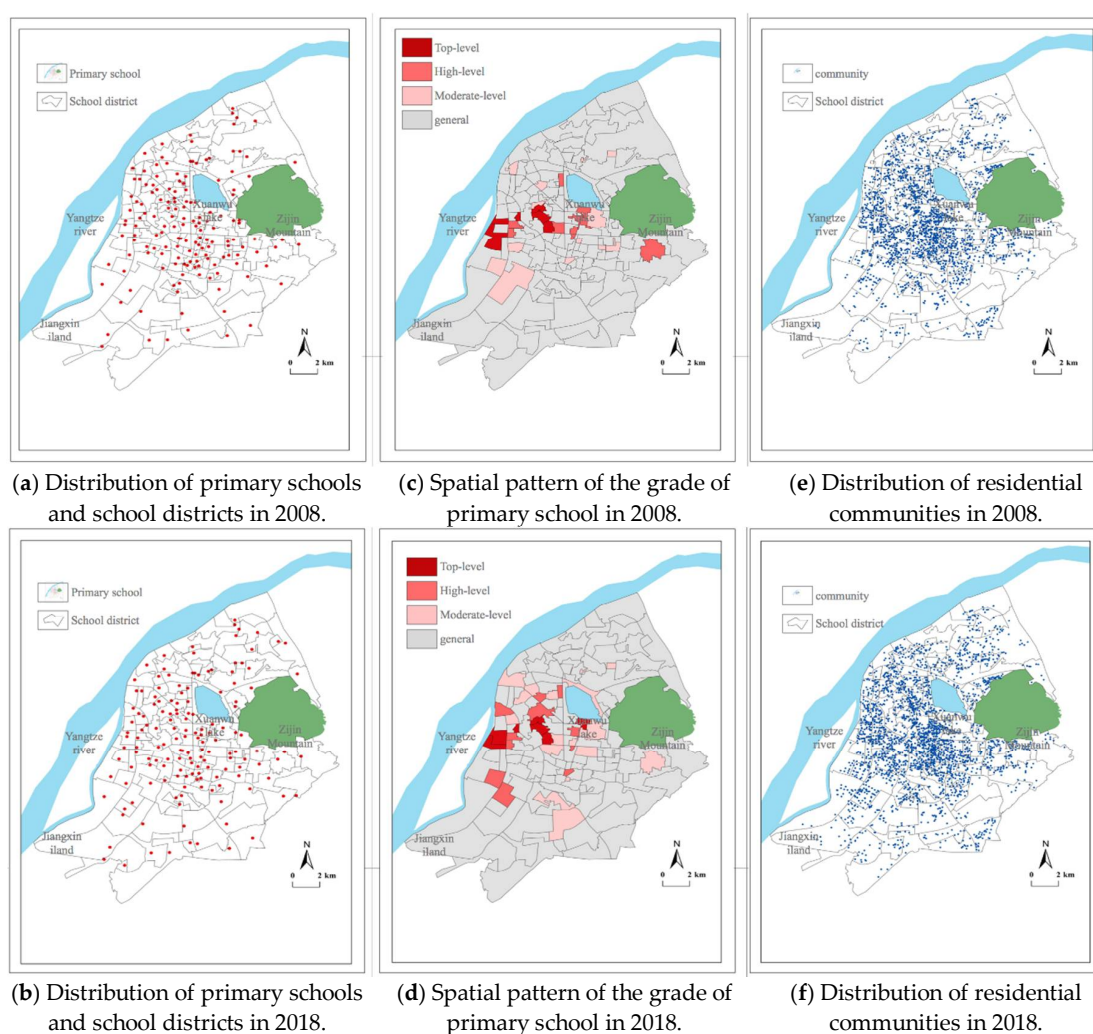

(**a**) Distribution of primary schools and school districts in 2008.

(**c**) Spatial pattern of the grade of primary school in 2008.

(**e**) Distribution of residential communities in 2008.

(**b**) Distribution of primary schools and school districts in 2018.

(**d**) Spatial pattern of the grade of primary school in 2018.

(**f**) Distribution of residential communities in 2018.

Figure 1. Research area and object. (**a**) Distribution of primary schools and school districts in 2008; (**b**) Distribution of primary schools and school districts in 2018; (**c**) Spatial pattern of the grade of primary school in 2008; (**d**) Spatial pattern of the grade of primary school in 2018; (**e**) Distribution of residential communities in 2008; (**f**) Distribution of residential communities in 2018.

Table 1. Education quality grades of public primary schools in the main city of Nanjing.

School Grade (Admission Rate)	2008	2018
	Quantity	Quantity
Top-level (>10%)	6	7
high-level (2–10%)	10	11
moderate-level (0.5–2%)	13	18
general (<0.5%)	125	107

Notes: The data in brackets are admission rates. The data for 2018 is replaced by 2017.

3.2. Calculation Methods

Based on the understanding of the social-spatial accessibility of urban educational resources, there are essential differences between diverse types of accessibility and its influencing factors [2,43,44]. Consequently, it is difficult to measure the overall accessibility index of educational resources by means of spatial overlay, weight assignment, and other quantitative means. The paper will perform the deconstruction and calculation using geography, opportunity, and economic accessibility measurements. The method is shown in Table 2 and Figure 2.

Table 2. Index of social-spatial accessibility of urban education resources and their calculation method.

	Geographic Accessibility Index	Opportunity Availability Index	Economic Affordability Index
Variable description	Average distance of road network from each community to school in the district	The ratio of residential housing scale in the school district to that in the study area	The ratio of average housing price to per capita disposable income in the school district
Calculation method	The sum of the shortest walk distance from each community to school in the district/the number of communities	The sum of the scale of each community in the district (the number of communities quality coefficient)/the total scale of residential communities in the study area	The average housing price per m^2 in the district/per capita disposable income
Notes	If a school has multiple addresses after merged, the authors will calculate the accessibility of each address and average the results.	Quality coefficient (building life-housing age)/building life. Building life is 50 years, which is the minimum standard according to General Code of Civic Construction in China.	Housing price is the transaction listing price. Per capita disposable income is that of cities and towns in the whole city of the year.
Unit	m	‰	year/m^2
Data sources	Data of residential communities about position, completion time, quantity and average price is provided by China House Price Market Platform. The locations of schools and the scopes of school districts are manually sorted out and drawn according to information publicly released by Nanjing Education Bureau. The vector network information is gained from Nanjing Planning Bureau. The data of per capita disposable income comes from Nanjing Statistical Yearbook.		

(1) The geographic accessibility index is gained by using the nearest distance method in the spatial accessibility measure to calculate the shortest distance from each community to school in the school district, and then to average the results, based on the vector information of residential communities, space points of schools, and the city road network (this is simple, intuitive, and easy to understand, but it does not consider some factors, such as space barriers, distance attenuation, and traffic mode selection).

(2) The opportunity availability index is affected by factors like the size of the school district, the number of units in it and the housing attribute. It is gained by simply calculating the ratio of the residential size in the school district to that in the study area, combined with the quantity and quality

of the housing (this can display the probability of spatial representation intuitively, but cannot reflect the objective reality that "some people have more opportunities than others").

(3) The economic affordability index reflects the economic cost of choosing a certain educational resource, essentially spatially implanting into a certain school district. It is gained by calculating the ratio of the average housing price per unit area to the per capita disposable income of urban residents in the school district (this is objective and easy to understand, but it only considers the cost of purchasing the "school district housing" and neglects other costs, such as transportation and supporting services).
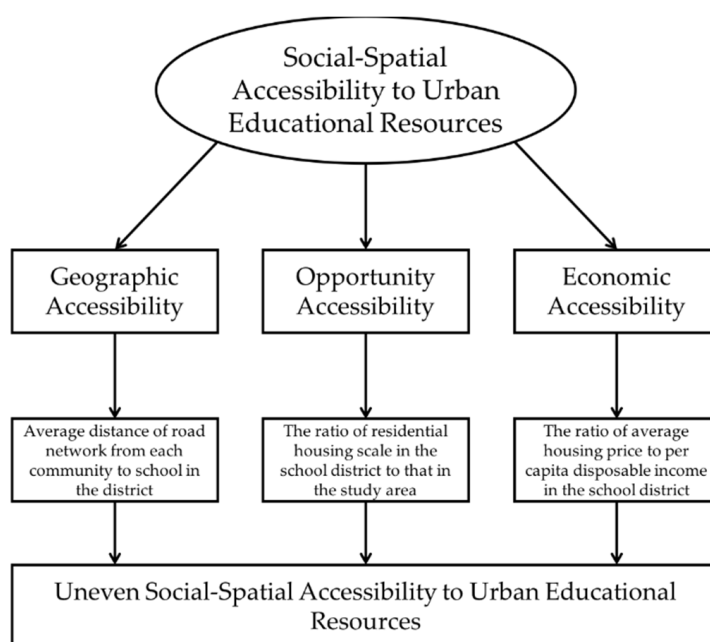

Figure 2. The conceptual diagram of the calculation method.

4. Pattern and Evolution of Social-Spatial Accessibility of Education Resources in Nanjing

4.1. Geographic Accessibility

Geographic accessibility is used to measure the proximity of the physical space between the place of residence and school. Based on the road network of the city, the minimum travel distance method is used to calculate the average walking distance of each residential community to a primary school in the school district, without consideration of the factors, such as road level, travel mode, street limit, and traffic congestion. It objectively reflects the average distance cost of residents' access to education services in the school district. The analysis on Nanjing shows:

(1) During 2008–2018, the average distance from the community to the primary school in the district has increased from 735 m to 840 m due to the expansion of the average area of the school district.

(2) Concurrently, when the average distance increases, the difference of spatial accessibility between school districts narrows significantly due to the merger of school districts in the inner-city and the separation of those in the outer-city. The school districts with the index of geographic accessibility that is higher than 2000 has decreased from five in 2008 to three in 2018, for example, and those with the index that is lower than 300 has decreased from 11 in 2008 to five in 2018.

(3) Reflected spatially, the geographic accessibility in the inner-city is significantly better than that in the outer-city in 2008, while it is more balanced both in the inner and outer-city in 2018 (Figure 3).
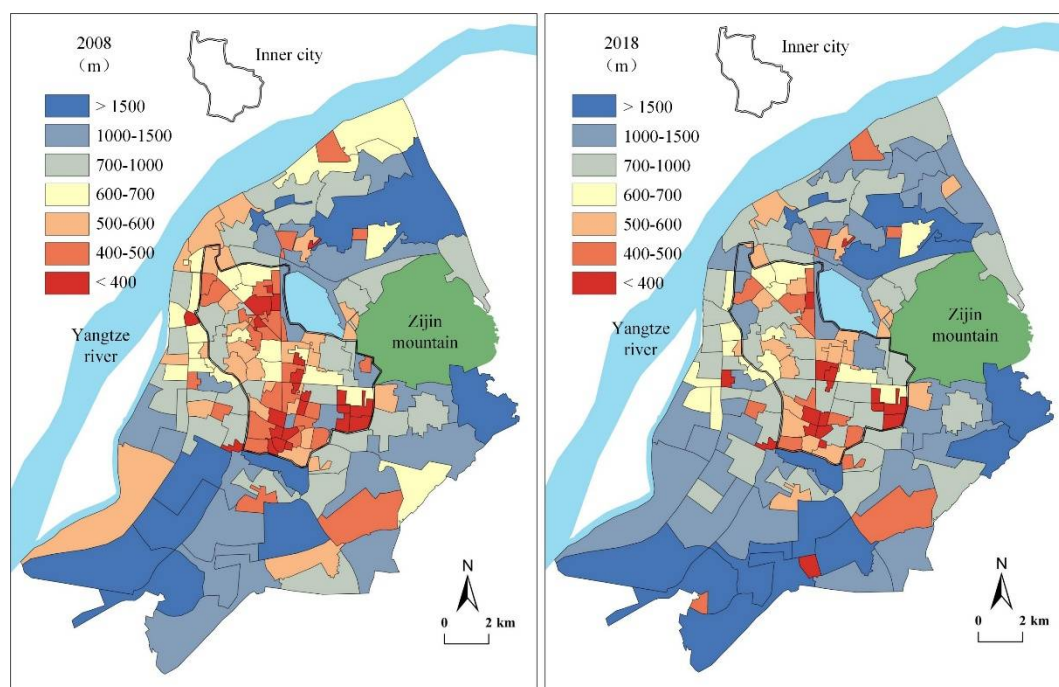
Figure 3. Spatial pattern and evolution of geographic accessibility.

4.2. Difference in Opportunity Availability

A strict school district system means that educational opportunities should match roughly with the scale of the residential areas in the school district, without considering exceptional cases, such as "selecting school cross districts". Based on full consideration of the number of houses in the school district, the housing quality coefficient with "age" as the parameter is introduced to modify the "residential scale". There are a large number of traditional multi-story houses in the city, especially in the inner-city. The area is aged, with old-fashioned structures, lack of property management, security, elevators, greening and parking space, all of which are the necessary supporting facilities for modern residential areas. The livability of housing is discounted significantly. Consequently, the authors introduce the housing quality correction parameters. Meanwhile, for comparative purposes, the proportion of the housing scale in each school district is calculated as the accessibility index. The results show that:

(1) The opportunity availability of educational resources in the school districts of the inner-city is weaker than that in the districts of the outer-city. While the former is relatively reduced, as houses in the inner-city are aging and under demolition, a large number of new houses are constructed in the surrounding areas, like Hexi New Town (Figure 4).

(2) The opportunity availability of top schools in the inner-city is reduced more significantly. Taking the top three primary schools in Nanjing: Lasalu, Lixue, and Langyalu primary schools (collectively known as "La-Li-Lang") as an example, the opportunity availability index of them have reduced from 0.88, 3.17, and 4.21, respectively, to 0.56, 1.93, and 3.23, respectively, during 2008–2018. However, the average index of the whole study area has gone up from 6.54 to 6.99 in the same period.

The actual difficulty for gaining top school resources, like La-Li-Lang, for example, is much higher than that reflected by the opportunity availability. There are many government agencies and institutions densely distributed in the school districts of La-Li-Lang, including the provincial government and Jiangsu Provincial Party Committee, the provincial Public Security Department, People's Hospital of Jiangsu Province, Nanjing Normal University, Hohai University, and so on, as well as many supporting family areas constructed by the above agencies and institutions before the reform of the housing market. There are few opportunities for an ordinary family outside the system to be

placed into the school districts of La-Li-Lang. In other words, admission can only be obtained for them through purchasing scarce new commercial housing or second-hand housing.
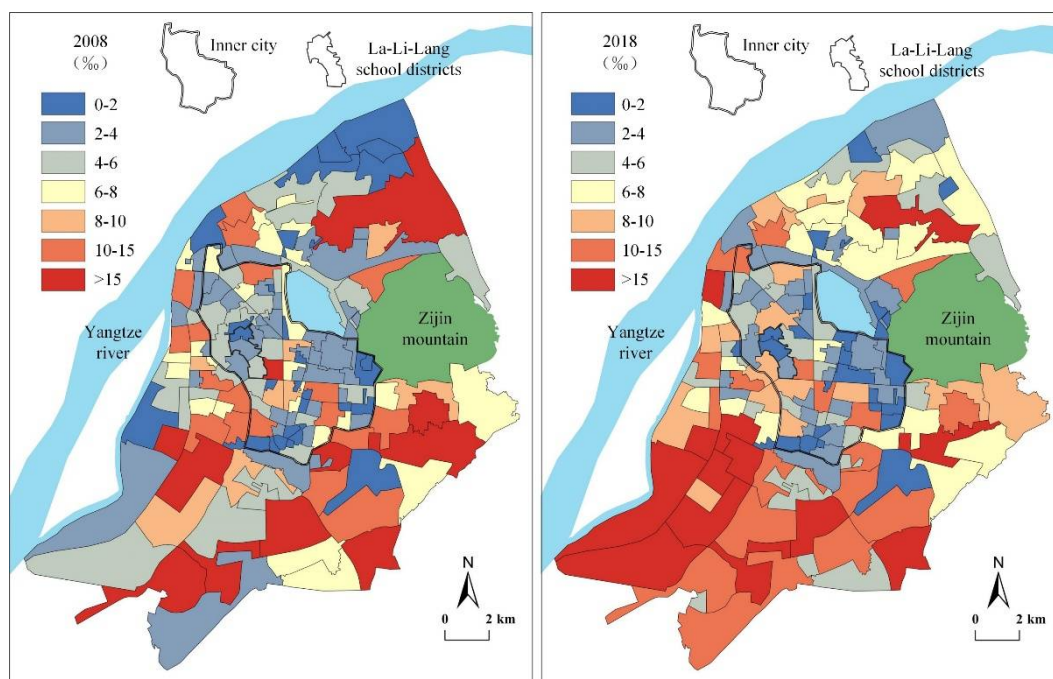

Figure 4. Spatial pattern and evolution of opportunity availability.

4.3. Economic Affordability

Economic affordability is used to measure the economic burdens of purchasing housing in the same areas in different school districts. The calculation results show that the average index of economic availability has increased from 0.47 to 0.56 during 2008–2018, while the economic cost increased faster for entering top schools. The average index of economic availability of the top ten schools has increased from 0.70 to 0.93 (Table 3), for example. The school districts in 2008, which were the most difficult in which to enroll via the economic way, were distributed in Gulou and Xuanwu Districts, both of which contained renowned schools. The economic availability of education resources in Hexi New Town by 2018 has increased sharply with the construction of new city centers (Figure 5).

Table 3. The ranking of economic availability to districts of the top ten schools.

Ranking	2008				2018			
	Name of the Primary School	Acceptance Rate (%)	Economic Affordability		Name of the Primary School	Acceptance Rate (%)	Economic Affordability	
			Index (year/m^2)	Ranking			Index (year/m^2)	Ranking
1	Lasalu	16.01	0.678	5	Langyalu	17.01	1.160	2
2	Langyalu	14.05	0.864	1	Lasalu	16.25	1.004	3
3	Lixue	12.24	0.826	2	Fangcaoyuan	15.60	0.980	4
4	Jinlinghuiwen	10.82	0.538	39	Beijingdonglu	13.20	0.711	19
5	Fangcaoyuan	10.24	0.777	3	Lixue	12.50	1.178	1
6	Yincheng	10.18	0.589	13	Yincheng	11.34	0.867	5
7	Nanshifuxiao	7.93	0.754	4	Jinlinghuiwen	10.07	0.861	6
8	Beijingdonglu	7.59	0.661	6	Nanshifuxiao	7.14	0.752	14
9	Tianzheng	5.58	0.601	9	Tianzheng	6.98	0.784	11
10	Hanjianglu	5.01	0.615	8	Youfuxijie	6.36	0.849	7

Notes: Only the rankings of Jinlinghuiwen in 2008 and Beijingdonglu in 2018 are quite different from those of their economic availability (the difference between the two rankings is more than 10).
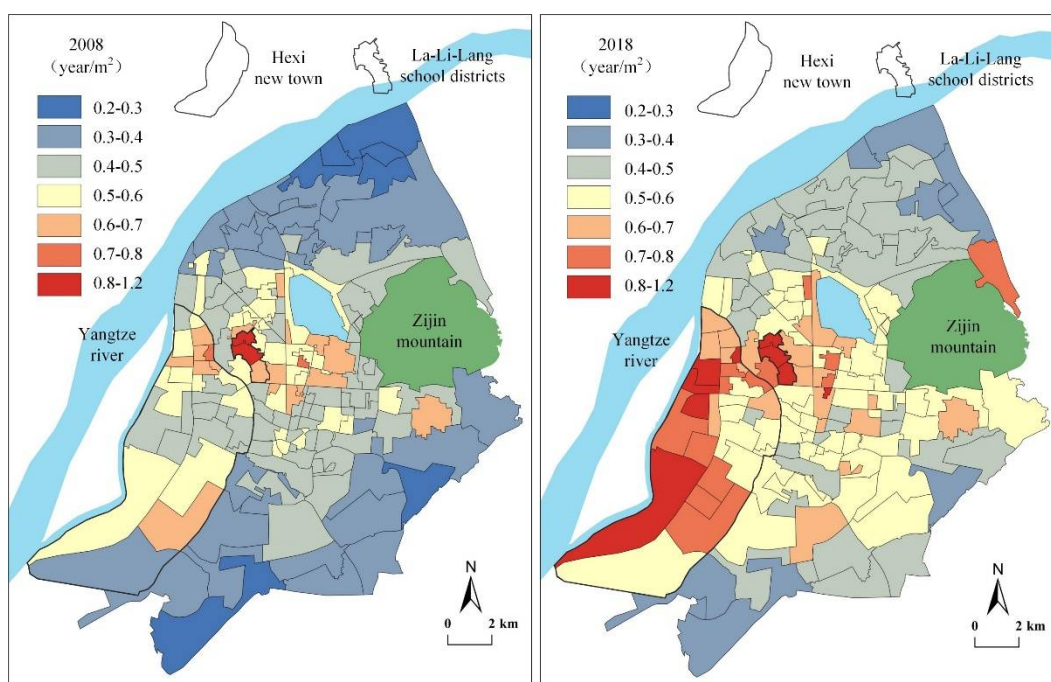
Figure 5. Spatial pattern and evolution of economic accessibility.

Generally, the increase of the average index of economic availability was driven by an imbalance that growth in incomes has been fast, but has not kept pace with the rapidly-rising house price during last ten years. For top schools, most of them focus mainly on urban centers and new towns of Nanjing. These areas have convenient transportation and developed economies, which further pushed up the house price and widened the imbalance. As a result, the index of economic availability of top schools remained high and increased rapidly. Moreover, the top school district house (*xuequ* house) caters to the demand of some new wealth to realize social reproduction through the realization of social advantage in education [45], and the heavy prices of these houses are a significant deterrent for average urban residents. These houses, which can provide the opportunity of obtaining HQER, thus became a tool for reproduction of the advantaged social class [7].

4.4. Comprehensive Evaluation

Figure 6 shows the time-space evolution path of the social-spatial accessibility of education resources. Geographic accessibility in the urban center is better than that in the periphery, however, the difference between them has steadily decreased in the past ten years. Alternatively to geographic accessibility, opportunity availability in the urban center is worse than that in the periphery and their gap is increasingly enlarged. The area most difficult to afford is the school district where the top school is located. The above accessibilities also show multiple and complicated spatial differentiation and evolution trends within the city. Educational resources of high quality are mainly concentrated in the northern part of the inner-city and its adjacent area of Longjiang in Hexi New Town. The three types of accessibility in the inner-city are weakening. Moreover, the higher the resource quality, the smaller the opportunity and economic accessibilities. Geographic and opportunity accessibility in the periphery are advancing, but education quality has not obviously improved.

According to the traditional spatial accessibility, the spatial distribution of educational resources has been more balanced in the main city of Nanjing during 2008–2018. However, from the perspective of opportunity and economic accessibility, the social-spatial imbalance of educational resources is still remarkable in Nanjing. The difference of urban educational resources is gradually formed under the long-term combined effects of many factors, such as history, system, urbanization, and marketization.

Consequently, its pattern has a stable continuity. To some extent, there is a social-spatial locking effect through the differences in educational resource accessibility. This causes and exacerbates the unfairness in the allocation of educational opportunities and quality and, thereby, brings negative impacts on social equity and sustainable development.
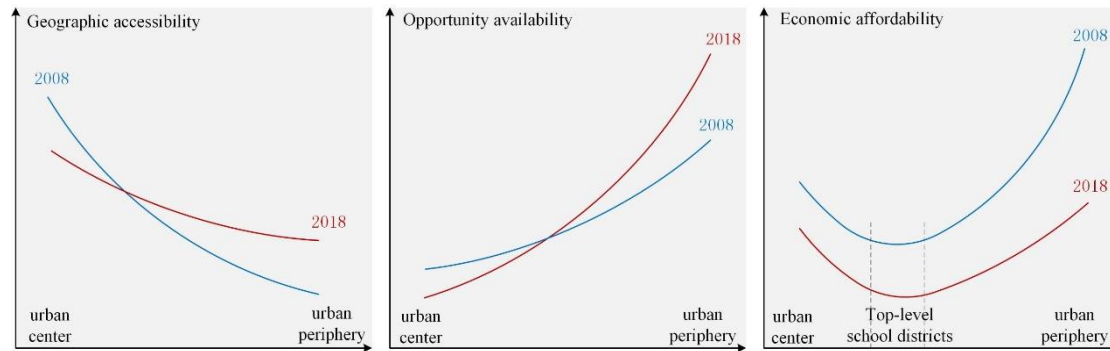

Figure 6. Time-space evolution path of social-spatial accessibility of education resources.

5. The Mechanisms of Social-Spatial Lock-In of HQER

5.1. Spatial Locking of Educational Resources Differentiation under Historical Inertia

Nanjing is known as the "ancient capital of the Six Dynasties". Education has been highly prized there. There was Jiangnan Gongyuan (Examination Hall) in ancient times, selecting more than half of Zhuangyuan (title conferred on the one who came first in the highest imperial examination) in the Ming and Qing Dynasties. Today, there are institutions of higher education only inferior to those in Shanghai and Beijing. Nanjing has 14 primary schools with histories of over 100 years, which are concentrated in the inner-city. The millennial history of urban development has a profound impact on the spatial differentiation pattern of contemporary educational resources in Nanjing. Specifically, Nanjing had formed the spatial pattern of "the ordinary residence in the south, the palace in the north" since it was fixed as the capital of Wu State in the period of the Three Kingdoms (220–280). Residential areas and neighborhoods were mostly located along the Qinhuai River south of the inner-city. Through the construction of capital cities in several dynasties, the urban function spatial pattern was continuously strengthened. Under the principle of "officials close to the palace, workers and merchants close to the residence", residents inhabited concentratedly according to their class and occupation. The southern part of the inner-city was a densely populated old city in the period of the Republic of China, while the northern part was the seat of the central political area, as well as the region where government employees and intellectuals concentrated [41,46]. During this century, the old town in the southern part of the inner-city is still concentrated by wage earners, while the northern part is mainly populated with residents of high social-economic status.

Due to this long-term accumulation of urban patterns, the northern part of the inner-city has a better quality of education than the southern part, with the aggregation of government agencies, research institutes and related practitioners. A spatial pattern of "strong in north, weak in south" has formed. La-Li-Lang is a typical example, which is located in the "senior government officials/intellectual gathering area" in the northern inner-city [46]. Additionally, Nanjing's urban construction was limited to the scope of 43 km^2, enclosed by the Ming City Wall, during the historical period from the construction of the city to the reform and expansion. Consequently, the urban population, as well as the educational, medical, commercial, and other public service facilities, are concentrated in the inner-city, which leads to a densely and fragmented pattern of the primary school districts. Moreover, the geographical accessibility of educational resources in the inner-city is significantly better than that in the outer-city.

5.2. Opportunity Locking of Educational Resources Allocation under the Unit System

The unit system has a more profound impact on the spatial allocation of educational resources compared to the urban historical accumulation that promotes the education quality of the northern city to be stronger than the southern part and educational resources of the inner-city to be denser than the outer-city. This has lasted nearly half a century since the founding of the People's Republic of China. During the planned economy period, the unit system was responsible for rationing housing, basic education, and other public services, forming a spatial organizational model that was self-contained, closed, and introverted. The unit system and its vicissitude is the best way to understand the transformation of urban social space in China [47], though it has disintegrated gradually since the reform and expansion. Thus far, China's urban structure has generally reflected the traces of the unit society. Some large communities of units, such as government agencies, research institutes, and state-owned enterprises, have been preserved and operate well. Under the school district system, they affect the social-spatial allocation of urban educational resources in a more hidden way [48]. There is a close historical and institutional origin of school district space and unit system space [49], in fact.

Many government agencies, institutions, and their staffs' families are located in the La-Li-Lang school district, thus, a substantial number of the students from these schools come from there, for example. These units' functions, and their resource allocation capabilities, make it easier for La-Li-Lang to acquire scarce educational resources. Along with the cumulative effect of strong faculty and excellent students, the phenomenon of "good units" supporting "good schools" frequently occurs. This means that families of staff from powerful units have more opportunities to receive high-quality education. More serious is that, though the proportion of "students choosing schools" is reduced with the rising voice of "abolishing school choice", schools will still provide "enrollment quotas" for their associated units or superior units. The better the school is, the more common the phenomenon of school choice. Thus, the school district is delimited to reduce the number of household enrollments. The areas of the La-Li-Lang school districts are 0.698 km^2, 0.843 km^2, and 0.498 km^2, respectively, in 2018, far below the average areas of 1.846 km^2. This leads to the extremely low accessibility of elite schools in the inner-city.

5.3. Pattern Locking of the Educational Quality Gap under Urban Expansion

During the early days of reform and expansion, there were 1.5 million people living in Nanjing's crowded inner-city, with the density of more than 30,000 people/km^2. The situation of population distributed in the inner-city had not fundamentally changed until the end of the last century. Housing marketization reform is a watershed. To displace the population densely living in the inner-city, Nanjing promoted the migration and diffusion of the inner-city and the new residents to the suburbs by planning and constructing the Hexi New Town and building a large quantity of new commercial houses. There were 760 residential communities in the study areas of 294.8 km^2 in 1998. Approximately 56% of the population were distributed in the inner-city, which constituted less than 15% of the total city area. During 1998–2008, 1298 residential communities were built in the area, among which 64% were in the peripheral area demonstrating obvious suburbanization. However, the construction of facilities of education and other public services lagged behind residential suburbanization because residential communities were constructed here and there during this stage. The number of homes that one primary school served, on average, was 10,272 in the peripheral areas, compared to 5633 in the inner-city in 2008. Combined with the scattered layout of residential communities, it directly led to a low accessibility of educational resources in the peripheral areas. During 2008–2018, the number of primary schools in the surrounding areas has increased by five, with the suburbanization of educational facilities, while the number in the inner-city has reduced by 16. Meanwhile, 91.7% of newly-built housing is distributed in the surrounding areas. Therefore, the accessibility of geography and opportunity of education resources is increasing there.

The differentiation pattern of urban educational quality is relatively stable, however. It is easy to increase the quantity, but difficult to balance the quality, which becomes a new problem in the allocation of educational resources in the peripheral areas. Other than the Longjiang Area that is close to the inner city the quality of primary school education in the periphery is relatively low. Located in the north of Hexi New Town, the Longjiang Area of Gulou District is the first new urban district of the Nanjing municipal government, containing many family areas of government agencies and institutions of higher learning. Many top-grade commodity housing has been built here, and these united with Langyalu, Lasalu Primary School, and other elite schools to build branch campuses, like the top ranking primary schools of Fangcaoyuan, Yincheng, and Jinlinghuiwen. Under the joint action of factors including government, unit and family, the above schools rapidly developed into the top schools in the city in less than 20 years. Additionally, this has not improved significantly during 2008–2018. Spatial disequilibrium has formed in educational quality, yet, the rapid expansion of the urban scale has magnified this imbalance effect obviously. The opportunity for high-quality education is becoming more and more scarce, and fewer people have a chance to enjoy it. Moreover, the school district system requires schools to assign an enrolment quota to schools according to household registration (family housing). This undoubtedly stimulated the consumption demand for school district housing of urban residents who desire to gain a high-quality education.

5.4. Economic Locking of Educational Resources Allocation under Market Renting

While the housing distribution system is reformed to a commercialized supply system, the educational resource allocation is gradually turning to the way of socialized supply, allowing for the choice for urban residents' liberalization from the traditional way based on the identity status of institutions. There is a social-spatial shift from distribution according to the social hierarchy to granting access rights according to the geographical territoriality of the school district [7]. This has made China's education system undergo a time-and-space change from welfare distribution to the market renting of neoliberalism [50]. Due to the qualification of educational resources being tied to the residential property rights in the school district, the purchase of a *xuequ* house is almost the only way for ordinary families to choose schools. Thus, the housing prices in the top-grade school districts are rising faster in the booming real estate market. However, some school enrollment conditions aggravate the scarcity of school district housing, for example, a house provides only one enrollment in six years, should the student live there for more than a year. This further increases the housing price and educational access threshold in the school district and reduces the economic accessibility of top-grade education resources.

Housing in a top-grade school district has become a luxury. Wealthy and middle-class families take the lead in the battle for top-grade education resources for mastering more economic capital. They are competing to buy a *xuequ* house at a high price for their children to gain a high-quality education and upward mobility opportunities by replacing the original residents having a lower income through purchasing their homes. Scholars call it *jiaoyufication* [7,8,51]. Additionally, it is believed that this might lead to residential segregation, education unfairness, and class consolidation.

6. Discussion: The Effects of Social-Spatial Lock-In of HQER

6.1. Urban Educational Resource Allocation Intertwine with Social-Spatial Reconstruction

The unevenness of urban educational resources have historical reasons accumulated over a period of rapid urbanization and market-oriented reforms. Since the acceleration of educational reforms in the late 1990s, different social-spatial accessibility to different quality educational resources affects the educational attainment of students, which can, in turn, affect the path of social mobility of different social classes [52]. Thus, social stratification will be strengthened by the different ability and opportunity for individuals to obtain educational resources.

Along with the educational reform, the promotion of residential space differentiation has been changed from the planned economy era of "industry" (such as the typical unit compound and workers) to free capital markets [53]. Social-spatial differentiation driven by the school district system, in essence, is a process that "spatially limited school catchment zones attract social groups who occupy these spaces in an attempt to facilitate social mobility or consolidate social status" [51]. Thus, due to the strengthening association between allocation of scarce HQER and urban (re)development and expansion [51,54], there is reason to believe that education affects not only social mobility, but also the urban socio-spatial differentiation and reconstruction.

6.2. Restricted Social Mobility and Educational Inequity under the Social-Spatial Lock-In of HQER

The school district system is designed to eliminate the impact of family background on school quota distribution, but it makes purchasing school district housing a means for high-income families to choose a school. Therefore, family background still has a profound impact on the allocation of educational resources through the differentiation of the opportunities and economic accessibility to educational resources among groups. Pierre Bourdieu's two capital concepts of "social capital" and "cultural capital" once dominated resource allocation in the "field" competition for educational resources, whereas, under the school district system, his "economic capital" is gradually rising to become the dominating factor. The hot "school district housing" continues to raise the competitive threshold of HQER. Thus, affluent families have more opportunities to study in renowned schools and realize the intergenerational transformation and transmission of economic capital to social and cultural capital. Furthermore, the locking mechanism of educational resource allocation and social-spatial differentiation is formed (Figure 7). High-quality education resources attract the groups with high economic and social status, which attach importance to the education of the future generations and attain living in a top-grade school district by methods like gentrification, thus forming residential space differentiation driven by education [7]. Additionally, by educational capital accumulation and social-status identification, future generations will have more and better opportunities to acquire ideal occupations and social status. However, due to the filtering effect of the real estate market, it is becoming increasingly difficult for low-income families to obtain HQER, which indirectly hinders the poor families in achieving social mobility through education, as well as increases their risk of being trapped in urban social and spatial margins.
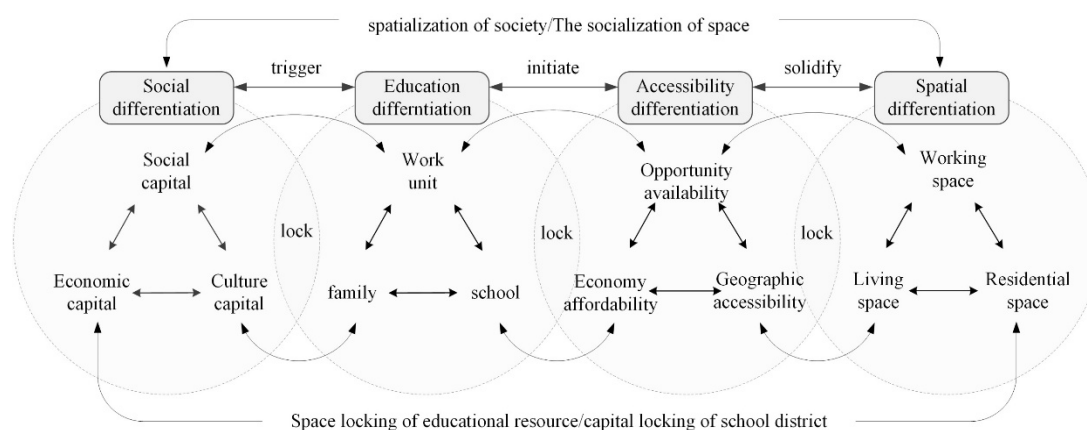

Figure 7. Social-spatial differentiation and the cyclic locking path of education resource allocation.

The fact remains that it is very difficult to achieve absolute educational equity under the premise of unbalanced educational resources and market allocation [47]. The above education inequalities caused by differences in educational resource allocation and social space locking is not, in the traditional sense, "the distribution of public services or facilities discriminated against specific groups in terms of institution and system" [48], but, if allowed to develop, scarce HQER will continue to flow and

gather into key schools, high-ranking groups, and dominant spaces. The consequence will be that ordinary families have less and less access to quality educational resources. Therefore, in view of the deep effect of education on social mobility, it is necessary to minimize the gap of educational resources between schools and groups in the city, and to improve the balance and the social-spatial accessibility of educational resources.

7. Conclusions: How to Conduct an Equitable Commitment between the Supply of and Demand for Educational Resources in the City

The root cause of inequity in education is the uneven distribution of educational resources in the urban social space. It is the fundamental way to achieve educational equity to reduce the differences in educational quality between schools and promote the reform of the school district system. The ways include delimiting the large school district, running schools by group, merging powerful schools and weak ones, promoting the intercollegiate flow of excellent teachers, directing education funds to weak schools, increasing school buses, and more. Particularly, through the readjustment of the school districts and the relevant supporting reforms, the spatial balance of educational quality and the social equality of educational opportunities can be promoted and advanced, which is an effective means to promote the balanced and sustainable development of urban education. However, both the importance of educational resources and the complexity of social effects makes it difficult to optimize and adjust school districts, especially those with high-quality schools. The district areas of the elite La-Li-Lang primary schools have not changed much, for instance, despite the frequent merger and adjustment of school districts in the inner-city of Nanjing in the past ten years. When the news that the Youfuxijie and Xiaohuowaxiang primary schools planned to merge came out in 2015, the Nanjing Education Bureau was soon mobbed by parents and housing owners in the school district of Youfuxijie, who strongly opposed the merger. The merger plan of the two schools was cancelled in the end. Thus, it is clear that the fair sharing of urban education resources will not be realized overnight. Only with the collective wisdom and long-term efforts of the government, education sector, and academia, can the renovation and innovation of the school district system be constantly advanced and, then, social-spatial justice and sustainable development can be promoted through educational equity.

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