Urban planning and population enhancement

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Abstract. This study examines the relationship between urban planning factors, specifically the number of schools, the number of teachers, and education funding, and their impact on population quality, using Nanjing as a case study. Through principal component analysis and multiple linear regression, the study reveals a strong correlation between the number of schools, education funding, and the number of graduates, indicating their crucial role in enhancing population quality. The findings suggest that increasing the number of schools and improving education funding can effectively contribute to the development and social progress of urban areas.

Keywords: urban planning, population quality, education funding, schooling

1 INTRODUCTION

In the context of China's evolving educational landscape, factors such as the number of schools, teachers, and education funding play pivotal roles in shaping the quality of the population. This study aims to analyze the impact of these factors on population quality, focusing on Nanjing as a representative case [1].

1.1 Number of Schools

The number of schools is one of the most important indicators of the level of educational development in a region. As the number of schools increases year by year, the coverage and acceptance of educational resources continues to expand, and more people are able to be influenced by high-quality education, the quality of which is also naturally improved. At the same time, with the increase in the number of schools, the gradual formation of healthy competition can also promote the overall level of schools continue to improve, for the training of human resources[5].

1.2 Number of Teachers

Teachers are the cornerstone of educational development, and the more teachers there are, the more important a role they play in the educational endeavor. As the number of teachers increases and the number of students in a class gradually decreases, teachers

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can give each student more attention and guidance to help them develop better. At the same time, more teachers can also mean more teachers with different backgrounds, experiences and ideas joining the educational enterprise, providing students with broader and more diverse perspectives and ways of thinking.

1.3 Financing of Education

Education funding is a necessary input for the development of education, and more adequate education funding usually means higher quality education resources and services. Reasonable education funding can help schools improve campus facilities, upgrade educational equipment, purchase teaching supplies and books, and so on, and provide support for more quality education activities. In addition, adequate education funding can attract more quality teachers to participate in education and create a better learning environment and more learning opportunities for students[2].

In summary, improvements in the number of schools, the number of teachers and education funding can all have a positive impact on the quality of the population. The combined effect of these factors will promote the continuous development of national education and the continuous improvement of population quality. In conclusion, university graduates play an important role in the development of the whole society, and they have an irreplaceable role in the improvement of population quality and overall social progress. Therefore, the training and support for university graduates should be strengthened to create a better environment for their employment and innovative development.

2 RESEARCH PROCESS

Taking Nanjing as an example, we study the impact of three aspects, namely, the number of schools, the number of teachers, and the funding of education, on the quality of the population [6].

This experiment takes Nanjing as an example to study the impact on the quality of the population in terms of the number of schools, the number of teachers, and the funding of education, where the quality of the population is reflected in the number of graduates at each stage each year [3].

2.1 Data Collection

By querying the National Bureau of Statistics, data on the number of schools, the number of teachers, education funding, and the number of graduates in NJ from 2013-2021 were collected. In table 1:

Table 1. Data Acquisition.

Number of schools	Number of teachers	funding for education	Number of graduates

Number of special education schools	Number of special education schools	Special education enrollment	Number of elementary school graduates
Number of elementary school	Number of elementary school	Elementary school enrolment	Number of general secondary school graduates
Number of general secondary schools	Number of general secondary schools	General secondary school enrolment	Number of high school graduates
Number of full-time teachers in high schools	Number of full-time teachers in high schools	High school enrolment	Number of general secondary school graduates
Number of general schools	Number of general schools	Enrolment in general secondary schools	Number of graduates of specialized secondary schools
Number of specialized secondary schools	Number of specialized secondary schools	Enrolment in specialized secondary schools	Number of undergraduate graduates
Number of general higher education institutions	Number of general higher education institutions	Enrollment of undergraduate students	Number of postgraduate graduates
		Graduate student enrollment	

2.2 Data Analysis

Principal Component Analysis.

The data will be downscaled using principal component analysis due to the large number of dimensions of the data in terms of number of schools, number of teachers, education funding, and number of graduates.

(1) Number of schools

Table 2. Explanation of Variance.

ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Variance %	Cumulative %	(grand) total	Variance %	Cumulative %
1	5.758	82.258	82.258	5.758	82.258	82.258
2	0.848	12.11	94.368			
3	0.177	2.527	96.895			
4	0.149	2.136	99.03			
5	0.059	0.836	99.866			
6	0.038	0.479	100			
7	0.000	0.000	100			

As shown in Table 2, the characteristic roots of each factor and the corresponding factor contribution, finally extracted a common factor that explains 82.258% of the information of the whole data, which is more than 80%, so it is considered that it can be satisfied as the result of principal component analysis.

Table 3. Factor Score Coefficients.

Number of special education schools	0.151
Number of elementary school	0.17
Number of general secondary schools	0.172
Number of upper secondary schools	0.141
Number of general secondary schools	0.172
Number of specialized secondary schools	-0.144
Number of general higher education institutions	0.149

From Table 3, the factor score coefficients included in each component, so that the composite data can be calculated in the following table:

Table 4. Number of Schools.

particular year	Number of schools
2013	118.949
2014	121.082
2015	122.748
2016	124.853
2017	129.76
2018	136.85
2019	141.839
2020	148.483
2021	151.688

(2) Number of teachers

Table 5. Explanation of Variance.

ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Variance %	Cumulative %	(grand) total	Variance %	Cumulative %
1	5.802	82.89	82.89	5.802	82.89	82.89
2	0.806	11.518	94.408			
3	0.331	4.723	99.131			
4	0.056	0.803	99.933			
5	0.004	0.057	99.991			
6	0.001	0.009	100			
7	0.000	0.000	100			

As shown in Table 4 and Table 5, the characteristic roots of each factor and the corresponding factor contribution, finally extracted a common factor, explaining 82.89% of the information of the whole data, which is more than 80%, so it is considered that it can be satisfied as the result of principal component analysis.

Table 6. Factor Score Coefficients.

Number of full-time teachers in special education	0.158
Number of full-time teachers in elementary school	0.171
Number of full-time teachers in general secondary schools	0.171
Number of full-time teachers in high schools	0.164
Number of full-time teachers in general secondary schools	0.171
Number of full-time teachers in specialized secondary schools	0.151
Number of full-time teachers in general higher education	0.102

From Table 6, the factor score coefficients of the factors included in each component, so that the composite data can be calculated in the following table:

Table 7. Number of Teachers.

particular year	Number of teachers
2013	22152
2014	22335.999
2015	22589.64
2016	23128.918
2017	23689.981
2018	24896.894
2019	25791.581
2020	26881.077
2021	27394.357

(3) Enrollment

Table 8. Explanation of Variance.

ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Variance %	Cumulative %	(grand) total	Variance %	Cumulative %
1	6.139	76.735	76.735	6.139	76.735	76.735
2	1.431	17.883	94.618	1.431	17.883	94.618
3	0.317	3.957	98.575			
4	0.06	0.749	99.324			
5	0.028	0.352	99.676			
6	0.022	0.275	99.951			
7	0.004	0.049	100			
8	0.000	0.000	100			

As shown in Table 7 and Table 8, the characteristic root of each factor and the corresponding factor contribution, finally extracted a common factor, explaining 76.735% of the information of the whole data, which is more than 70%, so it is considered that it can be satisfied as the result of principal component analysis.

Table 9. Factor Score Coefficients.

Special education enrollment	0.092
Elementary school enrolment	0.161
General secondary school enrolment	0.159
High school enrolment	0.153
Enrolment in general secondary schools	0.154
Enrolment in specialized secondary schools	-0.076
Enrollment of undergraduate students	0.158
Graduate student enrollment	0.159

From Table 9, the factor score coefficients of the factors included in each of the components are known, so that the composite data can be calculated as shown in the table below:

Table 10. Enrollment.

particular year	Number of students enrolled
2013	56089.6
2014	57290.722
2015	57506.022
2016	60148.755
2017	73873.538
2018	77161.975
2019	80850.088
2020	86037.492
2021	87608.833

(4) Number of graduates

Table 11. Explanation of Variance.

ingredient	Initial eigenvalue			Extract the sum of the squares of the loads		
	(grand) total	Variance %	Cumulative %	(grand) total	Variance %	Cumulative %
1	4.067	50.844	50.844	4.067	50.844	50.844
2	2.193	27.417	78.26	2.193	27.417	78.26
3	1.087	13.583	91.843	1.087	13.583	91.843
4	0.536	6.702	98.545			
5	0.078	0.976	99.521			

6	0.038	0.479	100			
7	0.000	0.000	100			

As shown in Table 10 and Table 11, the characteristic root of each factor and the corresponding factor contribution rate, finally extracted a common factor, explaining 50.844% of the information of the whole data, which is more than 50%, so it is considered to be basically satisfied as the result of principal component analysis.

Table 12. Factor Score Coefficients.

Number of elementary school graduates	0.251
Number of general secondary school graduates	0.283
Number of high school graduates	0.048
Number of general secondary school graduates	0.228
Number of graduates of specialized secondary schools	-0.176
Number of undergraduate graduates	0.014
Number of postgraduate graduates	0.284

From Table 12, the factor score coefficients included in each component, so the composite number can be calculated

According to the table below:

Table 13. Number of graduates.

particular year	Number of graduates
2013	64908.8
2014	63356.626
2015	63586.108
2016	63420.401
2017	64678.318
2018	64601.05
2019	69321.777
2020	73677.667
2021	74916.071

2.3 Regression Analysis

(1) Modeling

Multiple linear regression models for the number of schools, number of teachers, education funding, and number of graduates were analyzed as follows:

The multiple linear regression analysis was modeled as:

$$\begin{cases} y = \beta_0 + \beta_1 x_1 + \cdots + \beta_m x_m + \varepsilon \\ \varepsilon \sim N(0, \sigma^2) \end{cases} \tag{1}$$

in the formula $\beta_0, \beta_1, \cdots, \beta_m, \sigma^2$ are all parameters that are not related to

$x_1, x_2, \cdots, x_m$ are the last known parameters which are not related to each other, where $\beta_0, \beta_1, \cdots, \beta_m$ are called regression coefficients.

Now available n independent observation data $(y_i, x_{i1}, \cdots, x_{im}), i = 1, \cdots, n, n > m$, from (1) we get

$$\begin{cases} y_i = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_m x_{im} + \varepsilon_i \\ \varepsilon_i \sim N(0, \sigma^2), i = 1, \cdots, n \end{cases} \quad (2)$$

model solution

Table 14. Model Results Output.

regression coefficient	coefficient estimate	confidence interval (math.)
ε	-4.4473	[-1.2005,0.3111]
β_1	-0.0390	[-0.0444,0.0366]
β_2	0.0008	[-0.0001,0.0003]
β_3	-0.0001	[-0.0000,0.00001]
β_4	-0.0068	[-0.0017,0.00004]

Thus the following multiple linear regression model is derived as:

$$y = -0.0390x_1 + 0.0008x_2 - 0.0001x_3 - 0.0068x_4 - 4.4473 \quad (3)$$

From (3) by analyzing the output of the multiple linear regression model know the correlation between the number of graduates and the number of schools, the number of teachers, the number of enrollment, and education funding as follows:

The number of graduates has the highest correlation with the number of schools and education funding, followed by the number of teachers and enrollment.

Observing Table 13, it is known that the model presents a better overall result in the residual test, with only very one outlier; from Table 14, the model fits better and the error is within the acceptable range; in summary, it shows that the model performs well.

3 CONCLUSIONS:

This study underscores the critical role of educational factors in enhancing population quality and promoting urban development [4]. By prioritizing investments in schooling and education funding, policymakers can foster a conducive environment for societal progress and advancement. Furthermore, acknowledging the limitations of this study and offering recommendations for future research will enrich our understanding of the complex interplay between urban planning and population enhancement. In conclusion, a concerted effort to bolster educational infrastructure and funding is imperative for nurturing a high-quality population and fostering inclusive growth and development in urban areas.

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