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Research on the Balanced Development of Primary Education in Shaanxi Province

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Abstract

The balanced development of primary education is crucial to educational equity, so it is of great significance to study the balanced development of primary education in Shaanxi Province. This article first discusses the theories and research methods related to primary education. Using the primary education data in the "Shaanxi Statistical Yearbook" from 2012 to 2021, factor analysis and K-Means cluster analysis methods were used to conduct specific analysis and clustering of the development differences of primary education in ten cities in Shaanxi Province in 2021. The research results show that there is an imbalance in the development of primary education in different cities. Specifically, Xi'an City performs well in development, while Baoji City lags behind other cities. Finally, based on the research results, a series of relevant suggestions are put forward to promote the balanced development of primary education in Shaanxi Province. These recommendations aim to narrow the educational development gap between different regions and ensure that every student has access to equal educational opportunities, thus contributing to educational equity and social progress.

Keywords

Primary education, balanced development, factor analysis

1. Introduction

"The rise and fall of a country depend on education". Primary education, as the starting point of compulsory education, plays a vital role in every student's educational career. Under the trend of globalization, the equal development of education is an important aspect of social equity, which is not only helpful in promoting the harmonious development of Chinese society but also a necessary condition for realizing China's socialist modernization in 2035 [1]. Educational equity is the fundamental link to social equity, so the balanced development of primary education is the most fundamental requirement of fairness.

In order to consolidate the results achieved in the balanced development of primary education and comprehensively improve the quality of primary education, the Party Central Committee and the State Council have formulated important strategic arrangements. In addition, realizing equal opportunities in primary education is a requirement of our country's national conditions [2]. Only by achieving equal opportunities for primary education and effectively ensuring the educational rights of every school-age child so that they can complete the education years specified by the state can we prevent the emergence of a new generation of illiterate and semi-illiterate people, thereby turning the population burden on the masses into the first driving force for economic development. The current level of development of primary education in our country will help our country achieve a balanced development of municipal primary education, and the balanced development of regional primary education is the general trend [3].

2. Introduction of related theories and research methods

2.1 Correlation theory

2.1.1 Governmental functions

The government bears the main responsibility of promoting educational equity, and one of the basic functions of modern government is to ensure the public welfare and fairness of education. At the macro level, the education functions of the government should include five aspects: formulating education policies and planning, allocating public education resources, supervising education quality, providing public education services, and strengthening education supervision.

2.1.2 Cooperative Governance

Collaborative governance theory advocates equality between government, enterprises, and citizens, effective communication between government and enterprises, citizens have the right to participate in decision-making and implementation procedures and jointly serve social development. Similarly, the problem of balanced development of education also needs to be effectively solved [4].

2.1.3 Resource allocation

As we all know, all types of resources are always limited within a certain period of time. Therefore, the state should allocate these limited educational resources reasonably and scientifically in the field of education to make full use of the invested educational resources and maximize economic and social benefits. This is the “allocation of educational resources”.

2.2 Research method

2.2.1 Factor Analysis

Factor analysis is a multivariate statistical analysis method that studies how to condense many original variables into a few factors with the least loss of information, and to make the factors have certain naming interpretability.

(1) Select original variables according to the research question.
(2) Standardize the original variables find their correlation matrix, and analyze the correlation between variables.
(3) Solve the initial common factors and factor loading matrix.
(4) Factor rotation.
(5) Calculate factor scores.
(6) Conduct further analysis based on factor scores.

2.2.2 K-Means cluster analysis method

$K-Means$ clustering is also called fast clustering. It regards data as points in p-dimensional space, uses distance as an indicator to measure the "closeness" of individuals, and sacrifices multiple solutions in exchange for execution efficiency.

(1) Specify the number of clusters K.
(2) Determine K's initial class center points.
(3) Classify according to the principle of nearest distance.
(4) Re-establish K class center points.
(5) Determine whether the conditions for terminating cluster analysis have been met.

3. Empirical research

3.1 Data source

In order to analyze the factors affecting the balanced development difference in primary education, this paper selects the relevant primary education data from 10 urban areas in Shaanxi Province in 2021 as the research object. The data are obtained from the statistical yearbooks of all urban areas in 2021.

3.2 Variable selection

To the number of schools X_1, Enrollment number X_2, School enrollments X_3, Number of graduates X_4, The number of staff X_5, Number of full-time teachers X_6, Per capita disposable income X_7 as a variable.

3.3 Model building

3.3.1 Factor analysis of the model building

There are n samples, and each sample observes p indicators. There is a strong correlation between the p indicators. In

order to facilitate research, the observation data are standardized, and the original variables and standardized variable vectors are represented by X. Let $F_1, F_2, \ldots, F_m\ (m < p)$ represent the normalized common factor [5]. If:

(1) $X = (X_1, X_2, ..., X_P)'$ is an unobservable random variable, and the mean vector $E(X) = 0$, the covariance matrix $\mathrm{cov}(X) = \sum$, and the covariance matrix $\sum$ is equal to the correlation matrix R.

(2) $F = (F_1, F_2, ..., F_m)'\ (m < p)$ is an unobservable variable, its mean vector $E(F) = 0$, covariance matrix $\mathrm{cov}(F) = I$, and the components of each vector F are independent of each other.

(3) The components of $\varepsilon = (\varepsilon_1, \varepsilon_2, ..., \varepsilon_p)'$ and F are independent of each other, and $E(\varepsilon) = 0$. The covariance matrix $\sum_\varepsilon$ of ε is a diagonal square matrix.

$$\mathrm{cov}(\varepsilon) = \sum_\varepsilon = \begin{bmatrix} \sigma_{11}^2 & & & 0 \\ & \sigma_{22}^2 & & \\ & & \ddots & \\ 0 & & & \sigma_{pp}^2 \end{bmatrix}$$

That is, the components are also independent of each other, The model is as follows:

$$\begin{cases} X_1 = a_{11}F_1 + a_{12}F_2 + ... + a_{1m}F_m + \varepsilon_1 \\ X_2 = a_{21}F_1 + a_{22}F_2 + ... + a_{2m}F_m + \varepsilon_2 \\ \vdots \\ X_p = a_{p1}F_1 + a_{p2}F_2 + ... + a_{pm}F_m + \varepsilon_p \end{cases} \tag{3-1}$$

Called the factor model. The matrix form of the model (3-1) is:

$$X = AF + \varepsilon \tag{3-2}$$

In formula:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & & \vdots \\ a_{p1} & a_{p2} & \cdots & a_{pm} \end{bmatrix}$$

3.3.2 K-Means cluster analysis and model building

$K-Means$ clustering apply the Euclidean distance method and the proximity principle when classifying to determine the cluster center and the category to which the sample belongs. The formula is as follows:

$$d(X_i, X_c) = \sqrt{\sum_{j=1}^{w} (X_{ij} - X_{jc})^2} \tag{3-3}$$

In the formula, X_i is the sample $(i = 1, 2, 3, ..., Q)$, Qis the number of samples; X_c is the overall clustering center of the sample $(c = 1, 2, 3..., K)$, Kis the number of clusters; w is the number of attribute indicators of sample X_i; X_{ij} is the attribute index value of sample X_i; X_{jc} is the j cluster center $(c = 1, 2, 3, ..., K)$ of the indicator attribute; $d(X_i, X_c)$ is the Euclidean distance of sample X_i with respect to the cluster center X_c.

After sample X_i is calculated through formula (3-3), the sample is divided into K categories, and the average value of the samples in each group is calculated as the new cluster center. Then the distance between the sample and the cluster center is recalculated, and clustering is performed through multiple iterations. The classification is completed after the class center no longer moves. The formula is as follows:

$$X_{jc}^{(m)} = \frac{1}{h_t^{(m-1)}} \sum_{X_i \in D_t^{(m-1)}} X_i \tag{4-4}$$

In the formula: m is the number of iterations; $X_{jc}^{(m)}$ is the cluster center of the attribute index after the m-th iteration; $D_t^{(m-1)}$ is the classification result after the $m-1$ iteration $(i = 1,2,3,...,k)$; $h_t^{(m-1)}$ is the classification result in category $D_t^{(m-1)}$ after the $m-1$ iteration Number of samples.

3.4 Factor analysis

In this paper, the data of primary education in 10 cities of Shaanxi Province, the analysis method is set to principal component method, the factor analysis conditions are investigated from the correlation matrix, and the number of factors is determined by the maximum variance method to test whether the data can be analyzed [6].

Table 1. Model test table

KMO number of sampling suitability quantities		0.642
Bartlett sphericity test	approximate chi square	164.790
	free degree	21.000
	significance	0.000

According to Table1, bartlett's test of sphericity was 164.79, opposite $P = 0 < 0.05$, refusing the null hypothesis, the correlation coefficient matrix is significantly different from the unit matrix. $KMO = 0.642 > 0.6$, the original variables were considered acceptable for factor analysis.

Table 2. Factor variance interpretation

	Initial eigenvalue			The sum of the load squares was extracted			Sum of the rotating load squares		
component	total	Variance%	add up %	total	Variance%	add up %	total	Variance%	add up %
1	5.468	78.114	78.114	5.468	78.114	78.114	5.647	76.390	76.390
2	1.432	20.457	98.571	1.432	20.457	98.571	1.253	22.185	98.571
3	0.081	1.162	99.733						
4	0.012	0.167	99.900	-					
5	0.006	0.082	99.982						
6	0.001	0.013	99.995						
7	0.000	0.005	100.000	-					

Table 2 The variance contribution rate of the first factor was 5.468, explaining 78.114% of the total variance of the original 7 variables; The variance contribution of the second factor was 1.432, explaining 20.457% of the total variance of the original 7 variables, and the cumulative variance contribution was 98.571%. It can be seen that extracting the two factors explained 98.571% of the total variance of the original variable, with less information on the original variable loss. After factor rotation, the common degree of the original variable is not affected by any.

Table 3. Post-rotation factor load matrix

variable	F_1	F_2
X_1	0.955	0.275
X_2	0.793	0.481
X_3	0.784	0.455
X_4	0.773	0.496
X_5	0.759	0.506
X_6	0.751	0.507
X_7	0.338	0.924

From Table 3, the common factor F_1 number of in-school, enrollment number, school enrollments, number of graduates, the number of staff, and the number of full-time teachers has a large payload, it can be called an educational participation factor. The public factor has a large load on per capita disposable income, which can be called the educational dominant factor.

According to the factor score of each city, rank it with the help of Excel, the score ranking results are shown in Table 4.

Table 4. The res and comprehensive scores of primary education in Shaanxi Province

Region	The first common factor score	Ranking	The second common factor score	Ranking	Composite factor score	Ranking
Xi'an	171402.823	1	102759.361	1	157124.983	1
Baoji	-6902.739	10	34113.191	9	1628.574	10
Xianyang	33014.813	6	44642.341	6	35433.339	6
Tongchuan	51438.358	4	51230.300	3	51395.082	4
Weinan	58553.877	3	49070.683	4	56581.373	3
Hanzhong	32511.971	7	40350.071	7	34142.296	7
Ankang	31280.240	8	35502.854	8	32158.544	8
Shangluo	28924.059	9	32446.196	10	29656.663	9
Yunlin	33366.617	5	46452.769	5	36088.537	5
Yan'an	59110.075	2	55609.884	2	58382.035	2

3.5 K-Means cluster analysis

In order to better understand the differences in the balanced development of primary education in various cities in Shaanxi Province, this paper uses the clustering analysis of each factor score and the comprehensive score. The clustering results are shown in Table 5.

Table 5. Clustering results

Category	Region	The mean F1 score	The mean F2 score	Composite mean score
categoryI	Xi'an	171402.82	102759.36	157124.98
categoryII	Tongchuan, Weinan, Yan'an	59110.08	55609.88	58382.04
categoryIII	Xianyang, Hanzhong, Ankang, Shangluo, Yunlin	28924.06	32446.20	29656.66
categoryIV	Baoji	-6902.74	34113.19	1628.57

As shown in Table 5, educational participation and educational dominance in the 10 regions can be divided into four categories:

Category I: Primary education is developing very well. The scores of the first public factor (F_1) and the second public factor (F_2) in Xi'an are much higher than those in other regions, this shows that the primary education in Xi'an is sufficient both in terms of educational participation and educational dominance.

Category II: Primary education is developing well. The category includes three areas: Tongchuan, Weinan, and Yan'an. Little difference in scores between the first public factor (F_1) and the second public factor (F_2) in these three regions, which shows that education participation and educational dominance are in a good condition.

Category III: Primary education is developing relatively well. The category includes Xianyang, Hanzhong, Ankang, Shangluo, and Yulin. There is a certain gap between the first public factor (F_1) and the second public factor (F_2)aspect compared with the three regions of the second category, which shows that primary education still needs to be improved and improved.

Category IV: Primary education is not good. Baoji's first public factor (F_1) is the lowest and it's negative, it shows that Baoji is seriously insufficient in education participation and urgently needs to be paid attention to.

4. Conclusion

The results of comprehensive factor analysis and cluster analysis show that there are balanced problems in the development of primary education in ten cities in Shaanxi Province: Xi'an has the best development situation, which is far better than other cities both in terms of education participation and education dominance; Tongchuan, Weinan, Yan'an is slightly lower than that of Xi'an; Xianyang, Hanzhong, Ankang, Shangluo, Yulin and Baoji in education dominance, Baoji lags far behind other cities in its educational participation.

5. Suggestions

(1) Solve the problems of "school choice fever", "large class size" and shortage of teachers as soon as possible

Regarding the phenomenon of the "school choice craze" and "large class sizes", municipal governments should formulate plans and construction of primary education schools and ensure the allocation of funds for school building renovation and expansion to alleviate the problem of school building tension. At the same time, the principles of nearby admission and examination-free admission should be strictly implemented, and the phenomenon of cross-district admissions and illegal admissions in some key primary and secondary schools should be put to an end. Secondly, in response to the problem of teacher shortage, each school should promptly supplement the relevant teacher gaps according to actual needs and strengthen the construction of curriculum teacher teams. In addition, school construction and teacher recruitment efforts should be tilted towards rural areas, striving to reduce urban-rural differences.

(2) Cities should pay attention to education and try their best to narrow the gap between municipalities

In order to promote the balanced development of primary education in each city, we should actively develop the education undertakings in other cities, especially Baoji City, on the premise of ensuring the education level and education investment of cities with relatively high GDP, such as Xi'an, Tongchuan City, Weinan City, and Yan'an City. We must attach great importance to education, actively recruit school-age children, and strive to cultivate more outstanding students. Only in this way can we narrow the educational differences between municipalities and truly achieve educational balance.

(3) Strengthen the main responsibility of the government and improve the effectiveness of balanced development

As the leader in education, the government must clarify its responsibilities and play a strong macro-control role. First of all, we must increase educational support for rural areas and try our best to provide them with high-quality resources. Only in this way can we effectively promote educational balance. Secondly, focus on running primary education in ordinary schools so that primary education can achieve balanced development in the overall strategic layout. In addition, the government should pay extensive attention to the educational development of schools in various regions and provide them with timely support and assistance.

(4) Improve the evaluation mechanism of school education effects

The effectiveness of school education should not only be reflected in test scores, and this is not the ultimate goal of education. The score-only theory is blind and one-sided. Neither schools nor teachers nor even parents and students can be involved just in pursuit of high scores. Education should pay more attention to the differences of learners and teach students in accordance with their aptitude. Only in this way can the potential of the educated be maximized and their future study and life can be smooth sailing.

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