

# Efficiency Measurement and Improvement Suggestions of Urban and Rural Compulsory Education Resources

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## ABSTRACT

The rational allocation of educational resources is an essential link in education security. Based on the data of 2013-2014 academic year of China Education tracking survey, this paper uses the data envelopment analysis method to analyze the input-output efficiency of 70 schools in the sample from the perspective of input. The results show that the average value of input-output comprehensive efficiency of the sample is only 0.5825; The average value of input-output pure efficiency is only 0.6871; The average scale efficiency is 0.8370. The inefficiency of educational resource management plays a leading role, which indicates that the allocation of educational resources in the sample is unreasonable or wasteful. In order to avoid the shortage of education resources, this paper gives some suggestions from the aspects of controlling enrollment, unifying standards, training and allocating teachers, so as to achieve the goal of ensuring the balanced allocation of compulsory education resources.

**Keywords:** Educational resources; DEA model; Efficiency measurement; Quality of Education

## 1. INTRODUCTION

Compulsory education is an important link in the implementation of science and education to prosper the country and popularize education. But the contradiction between the economic development and the dual economic structure of urban and rural areas has led to the imbalance of the distribution of compulsory education resources in China. Many scholars have carried out many types of research on the allocation of educational resources. Li Yi and others used DEA model to study the allocation of compulsory education resources in urban and rural areas in the seven years after 2011 in 31 provinces in China. The conclusion is that the efficiency is generally low, and suggestions on finance, teachers and information technology are put forward. Lu saithrush and others used the spatial autocorrelation analysis method to study the provincial spatial order of compulsory education teachers allocation based on the current situation of compulsory education teachers allocation, and concluded that reasonable allocation of teachers could effectively reduce regional differences and improve the quality of education. Zhang Chunkun has made a survey and Study on the allocation of rural compulsory education teachers resources in the provincial area, and concludes that there are problems in the allocation of compulsory education resources in rural areas such as insufficient teachers and low quality. Jieguangmu and others use empirical analysis to study the factors restricting the improvement of education quality, and put forward suggestions to improve the conditions of rural education, so as to build the equalization of urban and rural education and narrow the

gap between urban and rural areas. EBA analyzes the gap between the educational infrastructure and the city in detail, and puts forward suggestions from policy, funds, evaluation and supervision to realize the balanced allocation of compulsory education infrastructure in urban and rural areas. Bailey analyzes the distribution and quality of educational facilities, and proposes a standard system for the integration of educational resources, and designs a suitable local plan for the allocation of educational resources. In conclusion, there are still many problems in the allocation of educational resources in China, which hinder the improvement of the overall education quality. In order to promote the harmonious development of compulsory education, this paper mainly uses the data envelopment analysis method to analyze the questionnaire data of junior high school principals in 2013-2014 academic year, and discusses the influence of teachers resources and teaching hardware equipment on the quality of education, And put forward targeted suggestions to help the final realization of the balance of urban and rural education and teaching quality.

It is the foundation of education guarantee to guarantee compulsory education resources, which is of great significance to improve the quality of compulsory education, promote educational informatization and build a complete education system. The concrete expression is: first, it is the foundation of education equity to allocate the resources of compulsory education reasonably, so as to make the right and opportunity of compulsory education benefit every child of the right and opportunity of compulsory education. Secondly, it can improve the quality of compulsory education, guarantee the students' access to high-quality education, and also an important measure to guarantee their right to receive good education.

Finally, it is conducive to eliminate the differences between urban and rural compulsory education, promote the sharing of urban and rural quality compulsory education resources, promote the integration of urban and rural education development, and strive to achieve "good learning" for all children and adolescents of the right age.

**2. CONSTRUCTION AND DESIGN OF EFFICIENCY MEASUREMENT MODEL**

**2.1. Data sources**

The data of this study comes from the questionnaire data of junior high school principals from 2013 to 2014 of China Education tracking survey. After eliminating invalid and missing data, 70 junior high school data were retained as sample data.

**2.2. Establishing input output index system**

In this study, the ratio of the number of teachers to the number of students is used as an indicator of human investment; The ratio of the number of available computers to the number of students and the ratio of the number of seats to the number of students are taken as the index of material and financial resources. The output index is the comprehensive score of junior high school.

**Table 1** Index system of efficiency measurement model

Index category	Index composition
Input index	Seat to student ratio X1
	Computer to student ratio X2
	Teacher to student ratio X3
Output indicators	Comprehensive score of junior high school Y1

**Table 2** Descriptive statistics of input-output indicators in efficiency measurement model

Variable	Average value	Standard deviation	Minimum value	Maximum
Output indicators:				
Comprehensive score of junior high school	3.9286	0.7861	1	5
Input index:				
Seat to student ratio	2.3460	1.7754	0.9208	9.9921
Computer to student ratio	0.1545	0.1121	0.0000	0.5394
Teacher to student ratio	0.1122	0.0466	0.0301	0.2909
sample size	70			

Note: the data are all from the questionnaire data of principals in 2013-2014 school year of China Education tracking survey

**3.2. The results of efficiency measurement model**

Based on C<sup>2</sup>R, this study calculates the efficiency from the input perspective; It is further divided into pure

**2.3. Building model algorithm**

In this study, a comprehensive evaluation model is used to evaluate the pure technical efficiency and scale efficiency of each decision-making unit at the same time C<sup>2</sup>R, It is used to evaluate the input-output efficiency of junior middle school. The formula of the algorithm is as follows:

$$\begin{aligned} & \min[\theta - \varepsilon(e^T W^- + e^T S W^+)] \\ & s. t. \sum_{i=1}^n X_i \lambda_i + W^- = \theta X_o \\ & \sum_{i=1}^n Y_i \lambda_i - W^+ = Y_o \\ & \lambda_i \geq 0; W^-, W^+ \geq 0 \end{aligned}$$

Among  $\theta$  For the efficiency of each decision-making unit;  $W^-$  represents the slack of input;  $W^+$  represents the surplus of output.

**3. ANALYSIS ON THE RESULTS OF THE EFFICIENCY MEASUREMENT MODEL**

**3.1. Descriptive statistical analysis of input output indicators in efficiency measurement model**

The descriptive statistical summary of the average value of input and output indicators in this paper is shown in Table 2. It can be found from table 2 The average comprehensive score of the sample is 3.9286, The average seat to student ratio is 2.3460, The average computer to student ratio is 0.1545, The average teachers to students ratio is 0.1122.

input-output efficiency and scale efficiency. The calculation results are shown in Table 3.

**Table 3** calculation results of efficiency calculation model

DMU	CCR-I-TE	BCC-I-PTE	SE	Returns to scale
School1	0.5141	0.6212	0.8276	IRS
School2	0.8784	0.8784	1.0000	-
School3	0.3903	0.5984	0.6522	IRS
School4	0.4242	0.5103	0.8313	IRS
School5	0.5220	0.5220	1.0000	-
School6	0.8619	0.8619	1.0000	-
School7	0.3509	0.4280	0.8199	IRS
School8	0.5972	0.9150	0.6527	IRS
School9	0.7518	0.8695	0.8646	IRS
School10	0.8634	1.0000	0.8634	IRS
School11	0.3492	0.5439	0.6420	IRS
School12	0.6925	0.8110	0.8539	IRS
School13	0.9246	0.9246	1.0000	-
School14	0.7418	0.8495	0.8732	IRS
School15	0.2826	0.6664	0.4241	IRS
School16	0.8903	0.8903	1.0000	-
School17	0.8672	0.9903	0.8757	IRS
School18	0.2634	0.4255	0.6190	IRS
School19	0.7247	0.8477	0.8549	-
School20	0.3074	0.3655	0.8410	IRS
School21	0.4913	0.4913	1.0000	-
School22	0.5264	0.6517	0.8077	IRS
School23	0.4233	0.4871	0.8690	IRS
School24	0.1613	0.2659	0.6066	IRS
School25	0.3263	0.3940	0.8282	IRS
School26	0.8466	0.8466	1.0000	-
School27	0.2963	0.3602	0.8226	IRS
School28	0.9973	1.0000	0.9973	IRS
School29	0.3508	0.4291	0.8175	IRS
School30	0.4331	0.5342	0.8107	IRS
School31	0.5814	0.6681	0.8702	IRS
School32	0.4334	0.5211	0.8317	IRS
School33	0.3016	0.3302	0.9134	IRS
School34	0.3445	0.3934	0.8757	IRS
School35	0.3370	0.4176	0.8070	IRS
School36	0.2584	0.4121	0.6270	IRS
School37	0.6582	0.7778	0.8462	IRS
School38	0.6667	1.0000	0.6667	IRS
School39	0.7790	0.7790	1.0000	-
School40	0.3742	0.4609	0.8119	IRS
School41	0.8757	1.0000	0.8757	IRS
School42	0.7696	0.8907	0.8640	IRS
School43	0.5827	0.6968	0.8363	IRS
School44	0.6919	0.8169	0.8470	IRS
School45	0.6938	0.8109	0.8556	IRS
School46	0.2567	0.3058	0.8394	IRS
School47	0.6523	0.7869	0.8289	IRS
School48	0.2903	0.6833	0.4248	IRS
School49	1.0000	1.0000	1.0000	-
School50	0.5816	0.5816	1.0000	-
School51	0.7214	0.8648	0.8342	IRS
School52	0.5924	0.7046	0.8408	IRS
School53	0.4675	0.5620	0.8319	IRS
School54	0.8607	0.8607	1.0000	-
School55	0.7469	0.8866	0.8424	IRS
School56	0.5179	0.6232	0.8310	IRS
School57	0.1033	0.1713	0.6030	IRS

School <sub>58</sub>	0.7906	0.9497	0.8325	IRS
School <sub>59</sub>	0.8386	0.8386	1.0000	-
School <sub>60</sub>	0.7819	0.9221	0.8480	IRS
School <sub>61</sub>	0.6525	0.7979	0.8178	IRS
School <sub>62</sub>	1.0000	1.0000	1.0000	-
School <sub>63</sub>	0.4538	0.5346	0.8489	IRS
School <sub>64</sub>	1.0000	1.0000	1.0000	-
School <sub>65</sub>	0.3405	1.0000	0.3405	IRS
School <sub>66</sub>	0.3697	0.4446	0.8315	IRS
School <sub>67</sub>	0.6497	0.6497	1.0000	-
School <sub>68</sub>	0.5580	0.6524	0.8553	IRS
School <sub>69</sub>	0.6505	0.7631	0.8524	IRS
School <sub>70</sub>	0.5019	0.5560	0.9027	IRS
average value	0.5825	0.6871	0.8370	-

According to the calculation results in Table 3, it can be found that, the average comprehensive input-output efficiency of the sample is 0.5825; The average value of pure input-output efficiency is 0.6871; The average scale efficiency is 0.8370. This shows that the overall input-output efficiency of junior high school is low, and there is likely to be a waste of input resources. Further analysis on the comprehensive input-output efficiency, pure input-output efficiency and scale efficiency shows that only 3 junior middle schools in 70 junior middle schools have achieved effective comprehensive input-output efficiency; Only 8 junior high schools' pure input-output efficiency has reached the effective state; Only 15 junior high schools have achieved effective scale efficiency; However, 54 junior high schools are in the state of increasing returns to scale, 17 junior high schools are in the state of constant returns to scale, and no junior high school is in the state of decreasing returns to scale. This shows that there is a large space for efficiency improvement in junior high schools, which needs to be analyzed in combination with their own situation.

## **4. SUGGESTIONS ON ENSURING THE BALANCE OF EDUCATIONAL RESOURCES**

### ***4.1. Scientifically control the number of students and implement the education voucher system***

With the rapid development of China's economy, the rapid growth of permanent population and large-scale population flow, the phenomenon of crowding out the educational resources in popular areas is becoming more and more common, and the educational resources in remote areas are seriously inclined to cities and towns. Under the vicious circle, people's demand for education in cities and towns is obviously greater than the amount of education resources in the region. With the full liberalization of the "two child" policy, the spatial imbalance of resource supply will intensify. This requires the government to guide the rational distribution of basic education resources at the

macro level, build a compulsory education system integrating urban and rural areas, and improve the contradiction between supply and demand. At the same time, the system of "compulsory education voucher" is introduced, that is, the government issues education voucher to citizens, the school-age population can pay education voucher to the school when they enter school, and the government allocates education resources through the education voucher received by each school, so as to know the students' preference more intuitively, and then further adjust the spatial layout of the school. To a certain extent, it can realize the synchronous flow of compulsory education funds with the education objects, and help the government to have the financial ability and motivation to protect the educational equality rights of local students and migrant children.

### ***4.2. Establishing a unified standard of resource allocation and financial allocation***

Quality education has been the main theme of compulsory education, and school hardware equipment, teachers and other resources are one of the standards of school evaluation. According to the guiding concept of "two oriented" and the principle of proximity, we should balance the demand and supply of educational resources. At present, the level of infrastructure construction of basic education in China is at different stages. It is necessary to achieve inter school equality between urban and rural primary and secondary schools and between urban primary and secondary schools at different levels through unified financial security and allocation of educational resources. The most simple and intuitive way is to make up for the shortage of hardware equipment directly by increasing capital investment and using finance. For example, as discussed in the empirical part, regarding the application of computer equipment in primary and secondary schools, we can set up a professional responsible group to inspect whether the computer equipment in primary and secondary schools in the jurisdiction area is reasonably put into use, whether it is regularly maintained, whether it has been idle for a long time or whether it is seriously insufficient, so as to allocate resources in time to make it meet the unified standards, Prevent the lack of equipment from affecting the

quality of education. After that, we need to normalize the financial investment mechanism to maintain the balance of resources, and formulate the public funding standards for compulsory education schools in accordance with the law, so that there is no big gap between urban and rural education equipment maintenance funds. Of course, the investment of this fund does not end when the infrastructure is built at one time. It will be a long-term process. The government needs to regularly investigate, evaluate and predict the long-term investment trend in the future.

### **4.3. Strengthen the training and reasonable deployment of Teachers**

At present, teachers are required to have strong professional qualities such as the ability to acquire and analyze information, the ability of innovation and self-study, and solid professional theory and teaching skills. Teachers in the stage of compulsory education are allocated to primary and secondary schools as human resources, and they often flow in different regions and posts with the development of society. If the flow of teachers is conducive to the construction of inter-regional teaching staff, it is benign to improve the quality of education in the region. On the contrary, if the blind flow disturbs the education plan or fails to play its own value, it is malignant. Another situation is the flow caused by market factors and administrative factors, that is, the personnel flow based on labor market allocation or administrative arrangements. In terms of the allocation of educational resources, the irrational flow of primary and secondary school teachers is the main reason for the unbalanced allocation of compulsory education teachers. Therefore, the rational development and utilization of teachers as a human resource, actively and steadily promote the benign flow of primary and secondary school teachers between urban and rural areas, strengthen the management of teachers, and improve the treatment of teachers in weak areas are the key to promote the balanced allocation of compulsory education teachers, It is an important strategy to promote the balanced development of basic education.

## **5. CONCLUSION**

The above suggestions are based on the results of empirical analysis and the existing research literature. Through the empirical research on the seat student ratio, teacher student ratio and computer student ratio, the results show that the input-output ratio is relatively low, which shows that there is unreasonable resource allocation in these three aspects, which is manifested as the lack of quality of educational resources or the waste of educational resources. This requires the government to allocate the

educational resources reasonably, so as to balance the number of teachers within a certain range, ensure that the hardware facilities are fully utilized and will not be redundant, and control the number of enrollment so that the educational resources in popular areas will not be blindly occupied. Finally, we should gradually expand the ranks of rural teachers, improve their working conditions, give them opportunities to continue learning and promotion, and improve the quality of education in an all-round way.

## **REFERENCES**

- [1] Li Yi, Yang Yan Ling, Wu Si Rui. Problems and Countermeasures of high-quality resource allocation efficiency in urban and rural compulsory education—Based on DEA Malmquist model [J]. Chinese Journal of education, 2021 (01): 60-65(In Chinese)
- [2] Lu Sai thrush, Pan Yu Jun. research on spatial order of Teacher Allocation in Provincial Compulsory Education in China [J]. Teaching and management, 2020 (21): 18-22(In Chinese)
- [3] Zhang Chunkun. Research on the integration of equipment management level in urban and rural compulsory education schools [J]. Asia Pacific Education, 2016 (16): 185(In Chinese)
- [4] Xie Guangmu, Ma Qing, Yang Wenfang. The current situation and Countermeasures of balanced development of teachers in urban and rural compulsory education in the province: a case study of primary school in n province [J]. Education theory and practice, 2012 (20) (In Chinese)
- [5]Ebba Ossiannilsson. Human Rights and Social Justice through Open Educational Resources and Lifelong Learning[J]. Macro Management & Public Policies, 2021, 3(1).
- [6]Smolarek Bailey B., Scrivener Luke. Examining business-driven education reform by new policy actors: a discursive analysis of UpSkill Houston[J]. Journal of Education Policy, 2021, 36(3).
- [7]Ahmed Tlili, Jingjing Zhang, Zacharoula Papamitsiou, Sven Manske, Ronghuai Huang, Kinshuk, H. Ulrich Hoppe. Towards utilizing emerging technologies to address the challenges of using Open Educational Resources: a vision of the future[J]. Educational Technology Research and Development, 2021(pre-publish).