Paradigm Academic Press
Research and Advances in Education
ISSN 2788-7057
FEB. 2025 VOL.4, NO.2

An Analysis of the Equilibrium of Compulsory Education in X City, Zhejiang Province: A Study from 2019 to 2022

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doi:10.56397/RAE.2025.02.05

Abstract

Based on the annual statistical report of education development in Zhejiang Province from 2019 to 2022, this study analyzes the balance of teacher resources, teaching facilities and information configuration of compulsory education in X City of Zhejiang Province by using the difference coefficient and Theil index. The research results show that the compulsory education in X City of Zhejiang Province has a good performance in the overall balance, but there are still obvious differences between counties in the structure of teacher education and the allocation of information resources. Therefore, it is suggested to alleviate the imbalance between teacher qualification and teacher structure through policy support; A series of measures, such as connecting educational resources, solving the imbalance of teaching instruments and teaching venues, are proposed to further promote the compulsory education in X City of Zhejiang Province to a higher level of high-quality and balanced development.

Keywords: educational equilibrium, difference coefficient, resource allocation, Zhejiang Province

1. Introduction

The key to realize educational equity lies in the balanced development of compulsory education. Zhejiang Province, as one of the economically developed provinces in China, has fully implemented the high-quality and balanced development plan of compulsory education at county level since 2016, and its effectiveness has an important demonstration role for other regions. Despite this, there are still significant differences in the distribution of educational resources between urban and rural areas and between different counties in Zhejiang province (Li Xiaoqiu et al., 2019). At present, most studies focus on the national scale or the central and western regions (Chen Battelle, 2021; Bai Wenqian et al., 2019), while micro-level analysis of differences within developed provinces is relatively lacking. This study selected the data of X City in Zhejiang Province from 2019 to 2022 as samples, focusing on the three dimensions of teacher security, teaching facilities and information resources, and deeply explored the characteristics and causes of the equilibrium of compulsory education in X City in this province, aiming to provide empirical research support for the optimization of the allocation of educational resources.

2. Methods

2.1 Data Sources

The basic data of compulsory education in X City of Zhejiang Province from 2020 to 2022 and the difference coefficient of quality balance of compulsory education in counties from 2020 to 2022 are all derived from the Annual Statistical Report on the Development of Education in Zhejiang Province from 2020 to 2022. Among them, the quality balance difference coefficient is calculated according to the evaluation contents and standards

such as resource allocation, government guarantee degree, education quality and social recognition degree stipulated in the Supervision and Evaluation Measures for the Quality and Balance Development of County Compulsory Education of the Ministry of Education. X City consists of 13 districts, counties and cities (10 districts, 2 counties and 1 county-level city).

2.2 Research Tools and Methods

The coefficient of difference (also known as the coefficient of variation or the coefficient of dispersion) is the ratio of standard deviation to the mean, while considering the influence of school size on the degree of equilibrium as a moderating factor. The equilibrium difference coefficient of compulsory education refers to the number of teachers with higher education qualifications per 100 students in the county, the number of backbone teachers at or above the county level per 100 students, the area of teaching and auxiliary rooms per student, the area of sports venues per student, the value of teaching equipment per student, and the number of network multimedia classrooms per 100 students.

$$CV=\frac{\sqrt{\sum_i^n \frac{P_i}{P_N}\times\left(X_i-\frac{X_i}{P_N}\right)^2}}{\sum_{i=1}^n \frac{X_i}{P_N}}$$

X_i represents the index value of the i school (junior high school or primary school) in the district/county equilibrium index system, P_i is the number of students enrolled in the i school (junior high school or primary school), P_N is the number of students enrolled in all junior high school (or primary school) schools in the district/county.

3. Results

3.1 The Guarantee of Teachers in Compulsory Education

3.1.1 Teacher Qualifications

In X7 District, X8 District, X11 County and X13 county-level city, the number of primary school teachers with bachelor's degree is less than 90%. Although the number of primary school teachers with bachelor's degree or above in X12 County is 91.8%, the inter-school difference coefficient is relatively high, reaching 0.68. Higher than the "County compulsory Education quality and balanced development supervision and evaluation Measures" issued by the Ministry of Education (hereinafter referred to as the "Measures") stipulated in the inter-school difference coefficient, primary schools are less than or equal to 0.50. In all districts and counties, more than 10% of junior middle school teachers have a master's degree or above, as shown in Table 1.

Table 1. Teachers' education background

	Elementary School			Middle school		
	Bachelor's degree or above quantity	Bachelor's degree or above ratio (X_i = 0.90)	CV	Graduate student or above quantity	Graduate student or above ratio (X_i = 0.08)	CV
X1 district	5094	0.978	0.15	752	0.267	0.15
X2 district	4555	0.961	0.19	814	0.286	0.25
X3 district	4365	0.987	0.21	486	0.206	0.21
X4 district	1911	0.982	0.30	275	0.241	0.14
X5 district	5412	0.903	0.16	246	0.071	0.17
X6 district	3875	0.947	0.34	403	0.199	0.25
X7 district	2525	0.870	0.31	127	0.071	0.14
X8 district	1768	0.858	0.22	66	0.059	0.25
X9 district	3375	0.926	0.14	406	0.204	0.10
X10 district	2420	0.980	0.37	261	0.197	0.14

X11 county	1268	0.804	0.21	59	0.062	0.17
X12 county	1435	0.918	0.68	14	0.016	0.44
X13 county-level city	1240	0.866	0.21	14	0.014	0.27

3.1.2 Teacher Structure

According to the requirements of the Detailed Rules for Monitoring the development level of Education modernization in counties (cities and districts) of Zhejiang Province in 2023, the teacher-student ratio in primary schools in the compulsory education stage is 19:1, and the teacher-student ratio in junior middle schools is 13.5:1. In addition to the teacher ratio in primary schools in X5 and X9 district, the teacher/student ratio in the remaining 11 districts and counties meets the modern education level, as shown in Table 2.

Table 2. Teachers' structure

	Primary school		Middle school	
	Number of full-time teachers	Faculty-student ratio (X_i=19:1)	Number of full-time teachers	Faculty-student ratio (X_i = 13.5:1)
X1 district	5206	15.654	2821	11.193
X2 district	4742	14.740	2844	10.750
X3 district	4421	17.257	2364	12.613
X4 district	1947	17.241	1139	9.586
X5 district	5995	19.078	3470	12.090
X6 district	4091	17.506	2022	11.763
X7 district	2902	16.334	1794	12.392
X8 district	2061	17.065	1128	13.311
X9 district	3645	19.760	1994	13.104
X10 district	2469	16.922	1325	11.426
X11 county	1577	17.166	956	11.770
X12 county	1563	10.372	891	8.924
X13 county-level city	1432	16.596	1003	10.298

The difference coefficient of backbone teachers at or above the county level per 100 students in X City conforms to the regulation of "all primary schools are less than or equal to 0.50, and all junior middle schools are less than or equal to 0.45", as shown in Table 3.

Table 3. There are backbone teachers at or above the county level per 100 students

	Elementary SCHOOLS		Middle school	
	Average	CV	Average	CV
X1 district	3.22	0.33	4.32	0.33
X2 district	3.43	0.36	4.34	0.42
X3 district	3.13	0.21	4.25	0.29
X4 district	1.55	0.23	2.62	0.31
X5 district	1.82	0.38	2.58	0.33
X6 district	1.68	0.34	1.73	0.40
X7 district	2.00	0.35	2.26	0.35
X8 district	1.67	0.37	2.33	0.35

X9 district	2.34	0.36	3.56	0.34
X10 district	1.51	0.24	1.82	0.18
X11 county	1.56	0.28	1.93	0.25
X12 county	5.80	0.30	6.04	0.28
X13 county-level city	3.18	0.25	4.30	0.21

The number of PE and art (art and music) full-time teachers per 100 students in primary schools and junior high schools in X City is 0.9 as a whole in line with the provisions of the "Measures", but X12 county has 1.64 PE and art (art and music) full-time teachers per 100 primary school students, which is a good level, but the difference reaches 0.60, greater than 0.5.

Table 4. PE and art (fine arts and music) full-time teachers per 100 students

	Primary Schools		Middle school	
	Average	CV	Mean value	CV
X1 district	1.27	0.16	1.13	0.25
X2 district	1.37	0.23	1.19	0.34
X3 district	1.17	0.15	1.04	0.27
X4 district	1.12	0.14	1.47	0.23
X5 district	1.00	0.16	1.06	0.21
X6 district	1.07	0.37	1.07	0.29
X7 district	1.07	0.36	0.98	0.27
X8 district	0.99	0.22	0.96	0.28
X9 district	1.18	0.17	1.14	0.22
X10 district	1.07	0.24	1.11	0.22
X11 county	1.00	0.20	1.17	0.19
X12 county	1.64	0.60	1.43	0.36
X13 county-level city	1.20	0.21	1.29	0.33

3.2 The Guarantee of Resources for Compulsory Education

3.2.1 Teaching Equipment

The average teaching equipment value of primary and junior high school students in X City is between 3434.343-5045.979 yuan and 4406.786-6864.919 yuan, as shown in Table 5, which is higher than the requirements of the "Measures" for primary and junior high schools to reach more than 2,000 yuan and 2,500 yuan respectively. However, the difference between schools in different regions is large, X3 district, X4 district, X5 district, X7 district, X10 district middle school students average teaching equipment value of the difference coefficient is higher than 0.45.

Table 5. Values of teaching instruments and equipment

	Primary School		Middle school	
	Equipment value per student (yuan)	CV	Equipment value per capita (yuan)	CV
X1 district	3925.228	0.26	5392.589	0.39
X2 district	4349.224	0.22	5756.317	0.43
X3 district	4980.556	0.28	6094.314	0.50
X4 district	4953.336	0.31	6864.919	0.50
X5 district	4854.942	0.29	5998.139	0.49
X6 district	4322.228	0.35	5627.513	0.43

X7 district	4716.775	0.47	5607.612	0.47
X8 district	5045.979	0.30	5048.532	0.34
X9 district	3434.343	0.15	4406.786	0.41
X10 district	4118.372	0.30	4976.602	0.50
X11 county	4362.321	0.23	6420.436	0.44
X12 county	4281.379	0.17	4971.774	0.43
X13 county-level city	4405.127	0.30	5915.062	0.44

3.2.2 Teaching Grounds

The Measures require primary schools and junior high schools to reach more than 4.5 square meters and 5.8 square meters, respectively. All primary and junior high schools in X City meet this requirement, and the difference coefficient is less than 0.45.

Table 6. Teaching and auxiliary housing area per student

	Primary Schools		Middle school	
	Average	CV	Average	CV
X1 district	6.10	0.25	7.66	0.19
X2 district	5.77	0.67	6.94	0.40
X3 district	5.49	0.23	7.21	0.24
X4 district	5.96	0.36	8.54	0.23
X5 district	6.31	0.35	8.21	0.32
X6 district	8.28	0.41	9.06	0.34
X7 district	5.50	0.32	8.33	0.21
X8 district	6.03	0.27	7.90	0.32
X9 district	7.41	0.31	10.49	0.35
X10 district	5.26	0.35	7.47	0.34
X11 County	5.31	0.27	6.97	0.37
X12 County	7.53	0.30	8.43	0.20
X13 county-level city	6.20	0.19	7.88	0.17

The average gymnasium area of primary school students and junior middle school students in X City is more than 7.5 square meters and 10.2 square meters respectively, and the difference coefficient is generally low. Only the difference coefficient of the gymnasium area of junior middle school students in X2 District is higher than 0.45.

Table 7. Per student sports venue area

	Primary Schools		Middle school	
	Mean value	CV	Average	CV
X1 district	8.60	0.16	11.17	0.13
X2 district	8.13	0.27	12.52	0.49
X3 district	8.36	0.27	11.80	0.34
X4 district	9.17	0.26	13.39	0.24
X5 district	10.11	0.30	15.68	0.29
X6 district	9.85	0.38	13.22	0.34
X7 district	10.05	0.25	15.46	0.31

X8 district	8.86	0.19	11.16	0.17
X9 district	9.36	0.23	14.90	0.17
X10district	9.70	0.36	12.39	0.33
X11 County	8.96	0.38	12.99	0.29
X12 County	9.67	0.29	19.80	0.28
X13 county-level city	10.81	0.27	15.40	0.26

The number of network multimedia classrooms per 100 students in primary and junior high schools in X City is more than 2.3 and 2.4 respectively, and the difference coefficient is low.

Table 8. Number of networked multimedia classrooms per 100 students

	Primary Schools		Middle school	
	Average	CV	Average	CV
X1 district	3.96	0.19	4.24	0.23
X2 district	3.78	0.25	4.50	0.43
X3 district	3.92	0.21	3.94	0.24
X4 district	3.36	0.17	4.11	0.28
X5 district	3.71	0.26	4.05	0.31
X6 district	3.94	0.37	4.51	0.40
X7 district	3.28	0.26	3.51	0.25
X8 district	3.27	0.25	3.40	0.27
X9 district	3.36	0.22	4.07	0.24
X10 district	3.68	0.36	3.26	0.35
X11 County	3.45	0.30	3.38	0.28
X12 County	4.90	0.39	4.41	0.24
X13 county-level city	3.74	0.20	3.68	0.17

4. Discuss

4.1 Analysis of Research Results

1) The Guarantee of Teachers in Compulsory Education

In terms of teacher qualifications, the proportion of teachers with a bachelor's degree or above in primary education in some districts and counties does not meet the requirements, and there is a significant difference between schools. For example, although the proportion of primary school teachers with a bachelor's degree or above is as high as 91.8% in X12 County, the inter-school difference coefficient is as high as 0.68, far exceeding the prescribed 0.50. This may be due to factors such as unbalanced urban and rural economic development and unequal distribution of educational resources. Rural schools often find it difficult to attract highly educated teachers because of their remote geographical location and difficult living conditions, resulting in a large difference in educational qualifications among inter-school teachers. However, the proportion of junior middle school teachers with master's degree or above is relatively high and has a certain balance, which reflects the importance of junior middle school teachers' educational requirements and the introduction of teachers is more standardized than that of primary schools.

In terms of teacher structure, except for X5 district and X9 district, the ratio of teachers to students in primary schools is not up to standard, and the remaining 11 districts and counties meet the requirements. The substandard teacher-student ratio will increase the teaching burden of teachers, affect the implementation of fine management and personalized education, and then reduce the quality of education. The difference coefficient of having backbone teachers at or above the county level per 100 students is basically in line with the regulations, indicating that X City has a certain balance in the distribution of backbone teachers. However, although the number of specialized sports teachers per 100 primary school students in X12 county is high, the difference coefficient is too large, which indicates that there is an imbalance in the inter-school distribution of sports

teachers in the county, which may be due to some schools not paying enough attention to sports education, or high-quality sports teachers are concentrated in a few schools.

2) The Guarantee of Compulsory Education Resources

In terms of teaching equipment, although the average teaching equipment value of X primary and middle school students is higher than the prescribed standard, there is a large difference between schools in different regions, and the difference coefficient of average equipment value of middle school students in some regions is higher than 0.45. This is due to the strong economic strength of some schools, which can invest more funds to update the teaching equipment, while some schools lack of funds, difficult to synchronize the update, thus exacerbating the inter-school gap. In terms of teaching venues, the average area of teaching and auxiliary rooms, the area of sports venues per student and the number of network multimedia classrooms per 100 students in each primary school and junior high school basically meet the requirements and the difference coefficient is generally low, but there are still large differences in individual regions. For example, the difference coefficient of the area of sports venues per student in junior high school in X2 district is significantly higher. This may be closely related to multiple factors such as urban planning and layout and geographical location of schools.

4.2 Countermeasures and Suggestions

According to the theory of educational equity, compulsory education should ensure that every student can enjoy equal educational resources and opportunities. This study shows that although the compulsory education in X city has made some progress in the aspects of teacher security and resource security, the problem of imbalance is still prominent, and there is still a big gap with the ideal state of educational equity. Studies have shown that the imbalance of educational resources will lead to the difference in education quality, which will affect students' academic performance and future development. The results of this study echo these studies, such as differences in teacher qualifications and teaching equipment may lead to differences in teaching quality of different schools, which is not conducive to the fair development of compulsory education. According to the theory of regional balanced development, inter-regional and intra-regional educational balance is the key to promote the overall progress of education. From the results of districts and counties in X City, the gaps in teachers and resources in some districts and counties reflect the lack of balanced development of education within the region. Failure to solve these problems may hinder the further development of compulsory education in the city.

1) The Imbalance of Teacher Qualifications and Teacher Structure Should Be Alleviated Through Policy Support

The government should increase investment in schools in rural and remote areas, and raise teachers' salaries and benefits, including housing subsidies and transportation subsidies, to attract highly educated talents to teach. We should strengthen the mechanism of teacher rotation and exchange, and promote balanced allocation of educational resources. We will regularly select and send key teachers to volunteer teaching in rural and vulnerable schools, and arrange for teachers from rural and vulnerable schools to study in quality schools. We will strengthen teacher training and improve the overall quality of teachers. Individualized training plans have been formulated to meet the needs of teachers in different regions and disciplines, especially the training of sports and art teachers to improve their teaching ability.

2) Through Policy Support, Ease the Imbalance Between Teacher Qualifications and Teacher Structure, Connect Educational Resources, and Resolve the Imbalance Between Teaching Instruments and Teaching Venues

Establish an educational resource sharing mechanism, and realize the sharing of high-quality teaching instruments and equipment and teaching resources through information means. For example, training on the use of online teaching instruments will be organized so that teachers in more schools can master advanced methods of using teaching instruments. Education funds should be reasonably arranged according to the actual needs and development of each school. For those schools with relatively weak teaching equipment and venues, more funds should be invested to improve the conditions for running schools. Urban planning should be optimized to give full consideration to the teaching needs of schools. In the construction or renovation of schools, the area of teaching and auxiliary rooms, sports venues, etc., should be reasonably planned to ensure that each school can have sufficient teaching space.

To sum up, X City in Zhejiang Province has made some achievements in the balanced development of compulsory education from 2019 to 2022. However, there is still an imbalance in teacher security and resource allocation. Through the analysis and suggestions put forward in this study, we hope to provide references for improving the balance of compulsory education and promote the development of compulsory education in Zhejiang Province in a fairer and higher quality direction. The future research should further broaden the horizon and comprehensively explore the multi-dimensional issues of compulsory education, in order to provide more solid theoretical support and practical path for its balanced development. In general, this study is based on the public data from 2019 to 2022, but the accuracy and comprehensiveness of the data may be limited, and some data acquisition may be biased, which is difficult to accurately reflect the actual situation. The study only takes

some districts and counties of X City as an example. Although it has certain reference value for understanding the balance of compulsory education in Zhejiang Province, it cannot completely represent the situation of the whole Zhejiang Province. The research mainly focuses on the situation of teacher security and resource security, and does not make in-depth discussion on other aspects of compulsory education, such as the quality of education and teaching, and the development of students.

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