Research on the Development Level of Modernization of Higher Vocational Education: Evidence from China

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Abstract: The modernization of higher vocational education cannot be separated from the social, economic and cultural environments. At the critical moment of the great rejuvenation of PRC and China's education reformation, as an important part of China's higher education, the modernization process of higher vocational education has attracted much attention. In order to evaluate the modernization level of higher vocational education in Chinese provinces and municipalities, this paper constructs a system of six first-level indicators based on the CIPP mode, including industry-teaching integration, exchange and cooperation, organization and implementation, talent cultivation, teaching reform and social service, which covers 31 second-level indicators and 39 specific indicators. After calculating the weight coefficients of the second level and first level indicators by using twice entropy method, the scores of the first-level indicators and the total scores are calculated, and the reasons are analyzed and countermeasures are put forward after interprovincial horizontal comparison.

Keywords: Higher Vocational Education; Modern Development; Chinese Characteristics

1. Introduction

Data from China's National Bureau of Statistics show that in 2023, there were 1, 242 general undergraduate schools and 1, 547 higher vocational (specialised) schools in China. A total of 10, 422, 200 students were enrolled in ordinary and vocational undergraduate schools nationwide, of which 5, 550, 700 were enrolled in higher vocational (specialised) schools. From these figures, it can be seen that higher vocational education has occupied more than half of the scale of Chinese higher education, So its importance cannot be underestimated. As an important part of higher education, higher vocational education is fundamentally different from ordinary higher education in terms of nurturing goals, cultivation methods and educational characteristics. With the acceleration of China's modernisation process, the highly skilled and qualified talents cultivated by higher vocational education have gradually become the backbone of the modernisation with Chinese characteristics. However, in the past development process of higher vocational education, due to insufficient attention, it did not taken care to the role of highly skilled personnel training. In recent years, the vocational education policy has been increasing, and the guiding documents have been promoted progressively, which has improved the social status and public recognition of vocational education, especially the role of higher vocational education has gradually been valued. Higher vocational education has both the research attributes of general higher education and the practical attributes of vocational education, which can be regarded as a more comprehensive type of education. Scholars generally believe that China's modernisation is learned from the Western societies, although scholars have called for a special path to achieve modernisation with Chinese characteristics, its specificity runs counter to the universality of Western-centred history [11]. In the twenty-first century, when the process of the great rejuvenation of PRC is accelerating, there is an urgent need to construct a modernisation evaluation system for higher vocational education with Chinese characteristics both compatible with Western modernisation.

2. Modernisation of Higher Education

2.1 Modernisation of Education

Since the early 1990s, many conceptual aspects of educational modernisation have

been systematically discussed, such as meaning, essence, principles, characteristics, values, typologies and practical guidelines. Thus, theoretical research on modernisation of education has accumulated fruitful results. Some scholars believe that the essence of educational modernisation is the growth and realisation of "educational modernity" [3]. Education modernisation can only be achieved by developing a broad view of education and organically combining the roles of nature, school, family and society [4]. In terms of the characteristics of education modernisation, Gu Mingyuan summarises education modernisation as eight characteristics, including democracy and fairness, lifelong and all-time, productive and social, informatization and innovation, internationality and openness, and points out in particular that these eight characteristics are mainly in terms of the conception of education, rather than an indicator system of modernisation [5]. Chu Hongqi puts forward the concept of China's education modernisation 2.0[2], which includes seven typical features such as humanity, democracy and rationalisation. However, these conclusions cover the whole education system, with primary and secondary education as the main object of discussion. Below we focus on the theoretical findings related to the modernisation of higher education.

2.2 Modernisation of Higher Education

Ye Guowen argues that the modernisation of higher education in China must build a higher education system and its ecology that matches the reality of China, which should be derived from Chinese history and self-consistent with the goal of modernising higher education in China [6]. This coincides with the "modernisation with Chinese characteristics" proposed in this study. Wang argues that the modernisation of higher education mainly refers to the establishment of a modern higher education system and a modern university system [7]. Therefore, China's index system for modernisation of higher education should have Chinese characteristics and the implementation elements of modern higher education system and university system.

2.3 Modernisation of Vocational Education

Follow after the study of connotation of

education modernisation, since 2014, when the State Council promulgated the "Decision of the State Council on Accelerating the Development of Modern Vocational Education", vocational educators have begun to explore the connotation of vocational education modernisation. Wu and Zhu pointed out that type, cross-border, and openness, these three key words constitute the target framework for the reform of modernisation of vocational education in China [1]. Cao Ye et al. pointed out that the modernisation of vocational education focuses on the "Ten Changes", i. e. typology, systematisation, synergisation, standardisation, institutionalisation, quality, informatisation, greenization, internationalisation and modernisation [8]. Chen Xiangyang developed a "provincial vocational education modernisation monitoring index system" based on the connotation of in-depth education modernisation and using the national vocational education policy documents as a blueprint, exploring the establishment of a provincial vocational education modernisation index system that includes five first-level indexes including the system, institutions, conditions, quality and vitality, and determined the weights of the indicators by the hierarchical analysis method [9].

The above definition of the meaning, characteristics and indicator system of vocational education includes two stages of vocational education: higher vocational education and secondary vocational education. However, secondary vocational education is essentially a vocational secondary education for underage students, while higher vocational education is a higher education with vocational characteristics for high school graduates. Therefore, many scholars unify secondary vocational education and higher vocational education in the study of modernisation of vocational education, although they can be compared in terms of connotation and characteristics, based on the difference of their cultivation objectives, different evaluation index systems should be constructed. Therefore, Chen Xiangyang's index system should be modified and improved to develop a modernisation index system applicable to higher vocational education.

3. Indicator System for Modernisation of

Higher Education

Educational development is closely related to politics, economy, society, culture and population, the construction of the education indicator system is also premised on this theory. the indicator system has a certain analytical framework, for example, the OECD education development indicator system takes the human capital theory as the theoretical basis, and takes the background, input, process and output in the CIPP model of education assessment to build a complete indicator system. Yang believes that we should also examine the growth of education "modernity", and the construction of fully quantifiable indicators and the quantitative results is the basic way of growth of "modernity"[3]. This is also the starting point of this research. Yu constructed a higher education modernisation indicator system that includes 8 primary indicators and 23 secondary indicators, including education scale, education quality, education efficiency, education input, education system, education structure, education management and education concept [10].

In conclusion, the relevant results on "modernisation of higher vocational education" are not rich enough at present, most of the literatures focus on "modernisation of education" or "modernisation of vocational education", and there are few studies on the modernisation of higher vocational education. Therefore, this paper will take the index system of modernisation of higher education and vocational education as the basis, combine with the characteristics of higher vocational education, and formulate a set of index system of modernisation level of higher vocational education that can reflect socialism with Chinese characteristics. This study solves the problem that the modernisation assessment indicators in previous studies are mixed with qualitative and quantitative, but cannot be calculated quantitatively and can only be explored theoretically. the most notable contributions is to make a comprehensive quantitative assessment of the high-quality development of each college in each region and derive score of modernisation, which provides an objective premise for the growth of "modernity".

According to the Opinions on Promoting the High-Quality Development of Modern Vocational Education issued by the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council in 2021, combined with the data from the "Report on the Quality of Development of Higher Vocational Education" in all provinces across the country in 2023, and using the CIPP model as the basic framework, combined with the modernisation index system of vocational education proposed by literatures, we have constructed the modernisation indicator system of higher vocational education with Chinese characteristics. the first-level indicators of this study include six items: integration of industry&education, exchange&cooperation, organisation&implementation, teaching reform, talent cultivation and social service. Among them, industry-teaching integration 、exchange&cooperation belong to the educational background category, organisation &implementation belong to the educational input category, teaching reform belongs to the educational process category, and talent cultivation and social service belong to the educational output category. the second-level indicators include 31 items, and the specific indicators used to assess the second-level indicators are 39 items, which are derived from the Report on High Quality Development of Higher Education (2023) issued by each province and municipalities. the complete indicator system is shown in **Table 1**.

Table 1.Indicator System and Weighting Coefficients for the Modernisation of Higher Education

First-level indicators	Second-level indicators	Specific indicators
Industry &education	Training inputs	1.1 Number of virtual simulation training sites (0.1432*)
	specific skill	1.2 Number of recipients of vocational skills level certificates (0.2011*)
	Enterprise Cooperation	1.3 Establishment of open regional industry-teaching integration practice centres with enterprises (0.1664*)
		1.4 Number of industry mentors engaged (0.1681*)
	Internship inputs	1.5 Special funding for per-student internships (0.3211*)
Exchange& cooperation	Acceptance of Visiting Students	2.1 Number of specialities receiving foreign students (0.1050*)
		2.2 Number of foreign students admitted (0.1256*)
		2.3 Number of Teachers Receiving Visiting Teachers from Abroad (0.0935*)

	international standard	2.4 Vocational education standards developed and adopted abroad (0.1049*)
	Overseas schooling	2.5 Number of schools operating abroad (0.1007*)
	Sino-foreign cooperation	2.6 Number of Chinese-foreign co-operation programmes (0.0832*)
	study abroad	2.7 Time spent by full-time teachers on mentoring and training abroad (0.1412*)
	Offshore positions	2.8 Number of full-time teachers holding positions in foreign organisations (0.1493*)
	International awards	2.9 Number of awards in foreign skills competitions (0.0967*)
Organisation &implementation	Manpower inputs	3.1 Student-teacher ratio (0.0022*)
	financial input	3.2 Level of financial allocation per pupil (0.0458*)
	Practical teaching inputs	3.3 Value of on-campus practical teaching equipment provided by enterprises per student (0.8883*)
	Investing in Research	3.4 Value of teaching and research equipment per student (0.0637*)
Teaching reform	Post Course Competition Certificate	4.1 Number of certificate programmes (0.0817*)
	Information Technology Education Reform	4.2 Number of e-learning courses (0.1093*)
	resource building	4.3 Number of specialised teaching resource banks (0.4941*)
	boutique programme	4.4 Number of online boutique programmes (0.1506*)
	Teaching materials development	4.5 Number of teaching materials produced (0.0969*)
	Teacher structure	4.6 Proportion of full-time teachers who are dual-teacher (0.0048*)
		4.7 Proportion of full-time teachers in senior professional and technical positions (0.0050*)
	Situation of professional groups	4.8 Proportion of professional groups (0.0577*)
Talent development	Number of trainings	5.1 Full-time enrolment (0.1970*)
	physical quality (in ideological education)	5.2 Pass rate in student fitness assessment (0.0033*)
	Learning Perspectives	5.3 Promotion ratio (0.1286*)
	Quality of employment	5.4 Monthly income (0.0093*)
		5.5 Proportion of employment in the secondary sector (0.0190*)
		5.6 Rate of self-employment (0.5797*)
		5.7 Percentage of promotions three years after graduation (0.0206*)
		5.8 Proportion of employment in large enterprises (0.0424*)
Social services	Horizontal services	6.1 Arrival of horizontal technical services (0.1937*)
	Vertical services	6.2 Vertical research funding arrivals (0.1559*)
	technology development	6.3 Income from technology property transactions (0.2554*)
	Public Service	6.4 Training hours for public interest projects (0.2658*)
	Social training	6.5 Non-academic training on-account provision (0.1292*)

Note: * are the weighted values for each of the specific indicators.

4. Research Methodology

The mainstream methods for comprehensive evaluation include hierarchical analysis (AHP), superiority chart method, comprehensive index method, entropy value method, factor analysis and principal component analysis, etc. the AHP and superiority chart method are subjective tendency approach, which are usually needed to be scored by the experts or through the questionnaire research, to get the weights of each indicator. the disadvantage of this method is that greatly influenced by the subjective views of experts and the choice of experts, their capabilities may cause bias to the results. the comprehensive index method is used to measure the relative level of multiple indicators, which can be called an index, such as the price index, environmental monitoring index, etc. However, the calculation using simple addition and multiplication does not take into account the weight coefficient, assuming that the default weight of all indicators is 1, so the use of information is insufficient. Factor analysis and principal component method make use of the principle of information condensation of data, use the variance explanation ratio for weight calculation. Although the weights are objective, the information condensation will cause information loss, which will undermine the results with a small amount of data. Entropy value method belongs to a kind of objective approach, which uses the information carried by the data to calculate the weights, and obtains totally objective weights. Entropy is a measure of uncertainty, the smaller the entropy, and the greater the weight; on the contrary, the

greater the entropy, the smaller the weight. the entropy method maximises the use of information to set the weights to produce the quantifiable results. This study includes six first-level indicators and thirty-nine second-level indicators, so the entropy value method will be used twice to calculate the weight coefficient of second-level indicators and first-level indicators respectively, then the weight coefficients of the first-level indicators will be used to calculate the modernisation level score of each province and municipality.

5. Data Source

In this study, 30 provinces and municipalities except Hong Kong, Macao, Taiwan and Tibet were selected as the research objects. Descriptive statistics for each indicator are shown in **Table 2**.

Table 2. Descriptive Statistical Characteristics of Specific Indicators

Specific indicators	minimum value	maximum values	Average	Standard deviation	median
1.1 Number of virtual simulation training bases (unit: one)	10	534	175.6	126.202	150
1.2 Number of recipients of vocational skills level certificates(unit: persons)	3815	442499	96542.3	87467.595	96106
1.3 Building an open regional industry-teaching integration practice centre with enterprises (Unit: units)	3	769	301.6	229.052	214.5
1.4 Number of industry mentors engaged (unit: persons)	214	22931	6645.733	5268.53	5545
1.5 Special funding for per-student internships (unit:tens thousands of yuan)	0.003	0.157	0.016	0.027	0.011
2.1 Number of specialities receiving foreign students (unit: one)	0	285	40.033	54.583	26
2.2 Number of foreign students admitted (unit: individuals)	0	3869	504.233	758.749	242.5
2.3 Number of Teachers Receiving Visiting Teachers from Abroad (unit: one)	0	368	108.5	112.143	73.5
2.4 Vocational education standards developed and adopted abroad (unit: one)	2	1917	233.833	349.714	146.5
2.5 Number of schools operating abroad (unit: one)	0	82	14.2	17.744	8.5
2.6 Number of specialities run by Chinese-foreign co-operation (unit: one)	0	118	29.833	31.513	19
2.7 Duration of full-time faculty mentoring and conducting training abroad (overseas)(Unit: person days)	0	59585	10962.5	15838.103	3415.5
2.8 Number of full-time teachers holding posts in foreign organisations (Unit: persons)	0	702	80.233	137.063	28
2.9 Number of prizes won in overseas skills competitions (unit: items)	0	651	141.133	168.963	92.5
3.1 Student-teacher ratio (unit:%)	13.05	23.64	18.412	2.234	18.13
3.2 Level of financial allocation per pupil (unit: yuan per pupil)	6780.66	61437.99	15830.95	10447.34	13317.5
3.3 Value of on-campus practical teaching equipment provided by enterprises per pupil (Unit: ten thousand yuan/student)	0	25.007	0.895	4.554	0.048
3.4 Value of teaching and research instruments and equipment per student (unit: yuan/student)	8037.18	69533.04	14874.56	11870.598	11587.9
4.1 Number of Courses for Certificate Integration (Unit: Courses)	540	18614	5503.367	4176.007	4485.5
4.2 Number of online teaching courses (unit: courses)	268	29738	6519.933	6352.672	4810
4.3 Number of specialised teaching resource libraries (unit: one)	36	18017	1010.767	3247.578	273.5
4.4 Number of online quality courses (unit: courses)	83	12546	2456	2737.063	1658.5
4.5 Number of teaching materials produced (unit: books)	50	6226	2032.7	1646.983	1525.5
4.6 Proportion of dual-teacher full-time teachers (unit:%)	31.07	73.45	52.963	9.26	53.04
4.7 Proportion of full-time teachers in senior professional and technical positions (unit:%)	21.42	41.1	28.362	5.169	26.675
4.8 Proportion of professional groups (unit:%)	0.099	0.818	0.166	0.133	0.14
5.1 Number of full-time students (unit: persons)	34452	1366243	513138.3	336956.31	505144
5.2 Pass rate of students' physical fitness assessment (unit:%)	65.64	95.84	81.045	7.06	83.115
5.3 Proportion of further education (unit:%)	0.038	0.736	0.179	0.116	0.167
5.4 Monthly income (unit:yuan)	2861.06	5492	3994.41	594.515	3870.44
5.5 Proportion of employment in the secondary sector (unit:%)	0.094	0.328	0.246	0.049	0.255
5.6 Rate of self-employment (unit:%)	0.59	26.53	2.716	4.707	1.365
5.7 Proportion of promotions three years after graduation (unit:%)	22.87	64.45	42.816	9.243	45.675
5.8 Proportion of employment in large enterprises (unit:%)	0.07	0.232	0.134	0.042	0.136
6.1 Horizontal technical service arrivals (unit: ten thousand yuan)	9	102406.1	14636.50	21844.009	6069.2
6.2 Vertical Research Funding Arrivals (unit: yuan)	60	20282.75	4133.038	5185.648	2184.43
6.3 Revenue from technology property rights transactions (unit: ten thousand yuan)	0.36	11892.02	1494.667	2669.768	435.365
6.4 Training hours for public welfare programmes (unit: hours)	457.67	3218667	516758.5	868981.70	102095
6.5 Non-academic training funds on hand (unit: tens of thousands of yuan)	458.58	134095.8	29264.05	32877.266	17844.2

6. Findings

6.1 Weight of Specific Indicator

The entropy method is first used to calculate the weights of the specific indicators, the greater the value of information entropy, the lower the weight of the indicator. The result is based on the raw data, not the normalized data. the result is marked in the table 1, where denoted with *in brackets.

6.2 Score of the First-Level Indicator

In order to make the score of first-level indicators are comparable, the raw data (specific indicator data) have to be normalized, the normalization formulation is shown in Equation①, where x_{min} denotes the minimum value of a specific indicator and x_{max} denotes the maximum value of a specific indicator. The x' is normalized data. The normalized data are utilized to caculate the score of first-level indicator.

$$x' = \frac{x - x_{min}}{x_{max} - x_{min}} \qquad (1)$$

After multiplying the weight of specific indicators with normalized specific indicators data, We can get the first-level indicator scores (The results are also normalized naturally). the score range of the first-level indicator is between 0 and 1, and the higher the score, the higher the degree of modernization of the first-level index. The calculation results are presented in **Table 3**.

Table 3. The Results of the Score of the First-Level Indicator

Provinces	Industry &education	Exchange &cooperation	Organisation of implementation	Teaching reform	Talent development	Social services
Anhui	0.305644	0.122063	0.008384	0.153243	0.227030	0.167046
Beijing,	0.356880	0.082534	0.120582	0.051815	0.191380	0.031694
Fujian	0.231486	0.151639	0.007423	0.111927	0.159526	0.186671
Gansu	0.224669	0.031620	0.006692	0.044188	0.155624	0.039105
hillsides	0.379222	0.496211	0.017568	0.374855	0.263452	0.399989
Guangxi	0.221522	0.184186	0.010123	0.100559	0.184987	0.196688
Guizhou	0.310090	0.161318	0.006330	0.071337	0.125585	0.046535
Hainan Island	0.062836	0.020668	0.026111	0.016733	0.152531	0.015355
anhui	0.262196	0.272642	0.011075	0.144181	0.180012	0.110452
Qinghai	0.526669	0.244876	0.003458	0.247665	0.288689	0.346156
Heilongjiang	0.099219	0.030317	0.005997	0.080773	0.096647	0.022447
Hubei	0.313679	0.121671	0.008602	0.170316	0.172549	0.168763
Hunan	0.225415	0.142979	0.009703	0.216658	0.193696	0.405621
Jilin	0.080038	0.076770	0.011751	0.057846	0.699282	0.059615
Jiangsu	0.531686	0.918815	0.020464	0.361743	0.227270	0.812621
Jiangxi	0.222978	0.139328	0.007906	0.115010	0.191619	0.224102
Liaoning	0.172824	0.046966	0.012259	0.098012	0.117325	0.025419
Inner Mongolia	0.143068	0.054412	0.017656	0.264942	0.132715	0.039600
Ningxia	0.056103	0.001901	0.023624	0.016492	0.073748	0.008658
Qinghai	0.005055	0.000000	0.040565	0.001954	0.033907	0.000903
Shandong	0.395481	0.240814	0.016567	0.597056	0.354357	0.191665
Shanxi	0.122425	0.029893	0.007073	0.057542	0.135580	0.023515
Shaanxi	0.212820	0.239983	0.012263	0.099322	0.164644	0.180610
Shanghai	0.061455	0.068490	0.934590	0.053158	0.099798	0.088032
Sichuan	0.331970	0.250592	0.010941	0.175102	0.215280	0.16017
Tianjin	0.085533	0.167972	0.016806	0.060632	0.092377	0.035389
Xinjiang	0.125198	0.016504	0.004005	0.048735	0.082634	0.063656
Yunnan	0.180007	0.074533	0.012125	0.057676	0.187530	0.074718
Zhejiang	0.394710	0.408387	0.023989	0.286651	0.280520	0.599487
Chongqing	0.210022	0.417839	0.010792	0.117614	0.191800	0.124723

Figure 1 is the kernel density estimation of the first-level index, and the kernel density plot is used to show the distribution of continuous data. The probability density distribution of different indicators can be visually displayed, and the kernel density distribution of six first-level indicators can be compared with the distribution differences of each index. It can be seen in the figure that except for the special distribution form of the organization and implementation of this index, the distribution of other indicators is relatively scattered. In particular, the two indicators of talent training and integration of industry&education are basically in line with the characteristics of normal distribution. Exchange&cooperation,

teaching reform and social services are also close to the normal distribution characteristics. Even if a small number of data on organization implements indicator is extreme, its pattern is close to normal distribution. This shows that even though the sample size of the study is not large, the data distribution is relatively scientific and reasonable, which helps to improve the credibility of the research results.
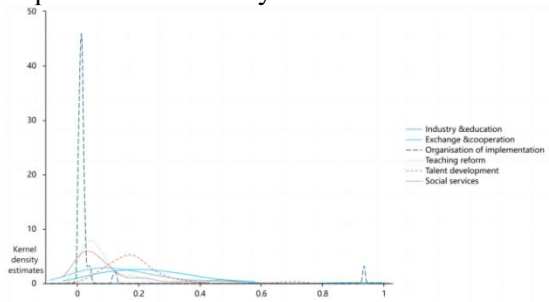

Figure 1. Kernel Density Map of First-Level Indicators

6.3 First-level indicator weights

The weighting coefficients of the six first-level indicators were calculated using the entropy method using the first-level index scores calculated by each province (**Table 3**), and the results are shown in **Table 4**. The information entropy value and the information utility value are only the intermediate values for calculating the weight coefficient, so we don't need to pay much attention to it. Here we focus on the weight coefficient data. From the calculation results, it can be seen that among the six first-level indicators, the organization and implementation are quite different, which can provide more information and utility, so its weight is the highest. This result is consistent with the morphological characteristics of the organization in the kernel density plot in **Figure 1**.

Table 4. Results of the Weight Coefficients of First-Level Indicators

First-level indicators	industry &education	Exchange &cooperation	Organisation of implementation	Teaching reform	Talent development	Social services
Information entropy	0.9463	0.8801	0.5249	0.9177	0.9565	0.8172
Information utility	0.0537	0.1199	0.4751	0.0823	0.0435	0.1828
Weight coefficient	0.0560	0.1253	0.4963	0.0860	0.0455	0.1909

6.4 Results of the Modernisation Evaluation

According to the weight coefficient of the first-level indicators calculated in Table 4, the modernization development index of higher vocational education in each province can be calculated, as shown in **Table 5**. The 30 provinces and municipalities are divided into five echelons according to the level of modernization. The first-echelon modernization score is above 0.20, the second-echelon modernization score range is 0.10-0.20, the third-echelon modernization score range is 0.08-0.10, the fourth-echelon modernization score range is 0.04-0.08, and the rest below

0.04 are the fifth echelon. What needs to be noted here is that the calculated score has no absolute significance, only a comparative effect. Through the comparison of scores, we can judge the level of modernization of higher vocational education, and roughly show the degree of difference. From the results, it can be seen that the provinces (municipalities) with the highest level of modernization are Shanghai, Jiangsu, Zhejiang, and Guangdong. The provinces with the lowest level of modernization are Gansu, Hainan, Heilongjiang, Xinjiang, Shanxi, Ningxia and Qinghai.

Table 5. Level of Modernisation of Higher Education

classification	Province (score)
First echelon (0.20 and above)	Shanghai (0.522688), Jiangsu (0.326583), Zhejiang (0.220246), Guangdong (0.204183)
Second echelon (0.10-0.20)	Shandong (0.168151), Henan (0.153847), Hunan (0.130016) Beijing (0.112299), Chongqing (0.109328), Sichuan (0.108205)
Third echelon (0.08-0.10)	Hebei (0.094628), Shaanxi (0.094127), Guangxi (0.090216), Jiangxi (0.089720), Hubei (0.089163), Anhui (0.089059), Fujian (0.083873)
Fourth echelon (0.04-0.08)	Jilin (0.067529), Inner Mongolia (0.064344), Guizhou (0.061308), Yunnan (0.052372), Tianjin (0.051000), Liaoning (0.042080)
Fifth Echelon (under 0.04)	Gansu (0.038402), Hainan (0.031676), Shanxi (0.030882), Xinjiang (0.030757), Heilongjiang (0.029609), Qinghai (0.024453) Ningxia (0.023144)

7. Conclusion

The modernization level scores of each province and municipality are differentially distributed on the map of provincial-level administrative regions using color bands. It can be seen that the provinces, autonomous regions or municipalities with a high level of

modernization are mainly distributed in the southeastern coastal areas, such as Shanghai, Jiangsu, Zhejiang, and Guangdong, which is convincing and in line with empirical judgment. These four provinces, autonomous regions and municipalities are the Yangtze River Delta and the Pearl River Delta region, which are the most economically developed regions in China. The more economically developed regions invest more in education, and because of their strong openness, there are more opportunities for international exchanges and cooperation. There are many advantageous industries, so more opportunities for enterprises to cooperate to implement the integration of industry&education, also can get more opportunities for social services. At the same time, the economically developed areas are highly attractive to talents, teachers of higher vocational colleges have advanced educational concepts, strong teaching skills, mature teaching reforms, and advanced teaching resources. In contrast, the regions with a low level of modernization of higher vocational education are concentrated in northern China. Including Xinjiang Province, Qinghai Province, Gansu Province, Ningxia Province, Shanxi Province, Heilongjiang Province in the northwest. In addition, Hainan Province, an island in southern China, also belongs to the fifth echelon with a low level of modernization. Northwest China is a vast region, but it is sparsely populated, lack of impetus for industrial development. In the inland area, the trade is not developed enough. In a small population, the concentration of outstanding talents is weak, a number of factors have contributed to the low level of modernization.

In addition to the overall evaluation of the development level of higher vocational education modernization in China, the horizontal distribution of each level index: integration of industry&education, exchange&cooperation, organization&implementation, teaching reform, talent training and social service.

As can be seen from the figure, Jiangsu and Henan belong to the highest level in the evaluation perspective of the integration of industry&education. Among them, Jiangsu, as a large economic province in the eastern developed region, has the advantages of strong industrial technology, rich scientific and

educational resources, and huge market scale. The manufacturing industry covers all 31 categories, and the added value of the manufacturing industry accounts for 14.1% of the country and about 4% of the world, making it one of the provinces with the most manufacturing categories, the most complete industrial chain and the most complete supporting facilities in China. In the first half of 2024, Guangdong, Shandong, Henan and other major economic provinces will have a rapid growth rate in industrial added value, playing a mainstay role in industrial growth and playing a leading role in industrial transformation and upgrading. It can be seen that Henan Province's GDP and industrial upgrading are also at the forefront. Jiangsu and Henan, which have a superior industrial and economic foundation, are at a high level of modernization in the field of higher vocational education, which can be said to complement their practical background.

In terms of exchanges and cooperation, Jiangsu Province is nearly double the score of Guangdong Province, which is ahead of the second place. The exchange and cooperation index focuses on evaluating the number and opportunities of international exchanges, cooperation and learning between teachers and students of higher vocational colleges. Jiangsu Province actively responds to the "Belt and Road" initiative, with the goal of cultivating international talents, and has taken positive steps on the road of internationalization of higher education, and has achieved remarkable results. Higher vocational colleges in Jiangsu Province rank first in the country in terms of the number of majors, the number of foreign students accepted, the vocational education standards developed and adopted by foreign countries, the number of schools opened abroad, the number of full-time teachers going abroad to carry out and guide training, the number of teachers holding positions abroad, and the number of awards won in skills competitions abroad. Although there is still a lot to improve on the road to internationalization, it is already at the forefront of China's provinces.

In terms of organization and implementation, Shanghai has the best implementation of higher vocational education investment and policy support, and its organization and implementation score is as much as eight times

that of Beijing, which ranks second. The per capita financial allocation level of Shanghai vocational colleges is several times that of other provinces and autonomous regions, the value of on-campus practical teaching equipment provided by enterprises per student is hundreds of times that of other provinces and autonomous regions, and the value of teaching and scientific research equipment per student is also in a high position. According to the statistics of education expenditure, in 2023, the per capita general public budget education expenditure of students in Shanghai's public general vocational colleges will exceed 39, 000 yuan. According to the data of the annual report on the quality of each school, the special financial allocation in 2023 will be 805.5723 million yuan, an increase of 40.60% over the previous year. In 2023, the value of on-campus practical teaching equipment provided by enterprises will reach 311.1955 million yuan, and the annual remuneration of industry tutors will be 440.795 million yuan. There are only 21 independent vocational colleges in Shanghai, but the economic strength is strong, so sufficient financial resources can be allocated to each higher vocational college.

In terms of teaching reform, Shandong Province took the lead, followed by Guangdong Province and Jiangsu Province. There are a total of 87 higher vocational colleges in Shandong Province, with abundant resources for higher vocational education, Rules for the construction of teachers of ideological and political theory courses in Shandong colleges and universities in the new era are strictly implemented.

There are 3, 358 ideological and political teachers in the province's higher vocational colleges, with a student-teacher ratio of 332:1. The sufficient teaching team has effectively guaranteed the teaching quality of ideological and political courses. In accordance with the requirements of the combination of education and training, the combination of long and short, and the combination of internal and external, they continue to increase the construction of carriers and resources. Create "gold majors, gold courses, gold teaching materials, gold teachers, gold bases", The integration of "post course certificate" improves the practical ability of technical and skilled personnel training. A number of high-quality teaching resources have been connected to the national

smart education platform. Shandong Province revised and developed 100 professional teaching standards, and selected and cultivated 126 first-class core courses. 217 kinds of national planning textbooks for vocational education in the first batch of the 14th Five-Year Plan were selected, and 22, 040 courses were opened.

In terms of talent training, Jilin Province has performed well and is far ahead. There are only 30 higher vocational colleges in Jilin Province, and the number of students is only 220, 000, which is disadvantageous in terms of the number. Jilin Province's high score in talent training mainly comes from the two specific indicators of self-employment rate and employment ratio of large enterprises, especially the entrepreneurship rate. The nationwide self-employment rate of college graduates is 2.716%, but the self-employment rate in Jilin Province has reached 26.53%, which is far higher than the average, and the proportion of employment in large enterprises has reached 23.17%, which is the highest level among all provinces and municipalities in China. Therefore, the high entrepreneurship rate and employment rate of large enterprises make Jilin Province have bright spots in talent training. Jilin Province is the representative of China's old industrial base, and China FAW, which has the largest automobile volume in China, drives industrial development. From 2017 to 2022, FAW recruits 10, 876 vocational college graduates every year. Simultaneously, Jilin has developed tourism in recent years, and the vigorous development of tourism and ice and snow economy have also brought more entrepreneurial opportunities.

Finally, in terms of social services, Jiangsu and Zhejiang performed well, especially the level of social services in Jiangsu is much higher than that of other provinces and municipalities. Since 2020, the number of invention patents granted by Jiangsu higher vocational schools, Service contribution indicators such as the amount of horizontal technical services and the economic benefits generated by horizontal technical services have continued to rise, with an average annual growth rate of more than 1.3 times. In 2023, 19 schools in Jiangsu Higher Vocational Schools received more than 20 million yuan in horizontal technical services. There are 18 schools with economic benefits of more than 100 million yuan for horizontal

technical services, and 12 schools have received more than 10 million yuan for non-academic training. These figures are among the best in all provinces in the country. Relying on its super economic strength, reasonable industrial structure, and the gathering of high-quality talents, Jiangsu Province is constantly expanding a new starting point for social services in higher vocational colleges.

Acknowledgements

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