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The Connotation, Measurement, and Pathway to Realizing Chinese-style Higher Education Modernization

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Abstract: *Higher education is a key indicator of a country's development level and potential. The modernization of higher education is integral to Chinese-style modernization. This paper constructs an evaluation system for the modernization of higher education in China, based on the CIPP evaluation model (Context, Input, Process, and Product), incorporating 26 specific indicators. Using the coefficient of variation method, it measures the average level of higher education modernization in China's provinces, eastern and central regions during 2010-2022. Based on these findings, specific pathways are proposed to advance the modernization of Chinese-style higher education, supporting the building of a strong educational nation and facilitating Chinese-style modernization.*

Keywords: *Chinese-style higher education modernization; CIPP evaluation model; Coefficient of variation*

1. Introduction

As an essential component of education modernization, higher education modernization serves both as a major driver of national modernization and as a critical link in the nation's modernization process (Yuan and Li, 2021)[1]. The Chinese Communist Party Central Committee and the State Council issued China Education Modernization 2035, outlining the direction for higher education modernization. The Third Plenary Session of the 20th Central Committee emphasized that "education, science and technology, and talent are foundational and strategic supports for Chinese-style modernization. It is essential to deeply implement the strategies of rejuvenating the country through science and education, strengthening the nation through talent, and driving development through innovation. Efforts must be made to advance an integrated reform of the systems and mechanisms for education, science and technology, and talent. A new state-led system should be established to enhance the overall efficiency of the national innovation system." Education modernization has become a crucial indicator of Chinese-style modernization. As the pinnacle of the national education system, higher education is integral to the overall modernization process of society and directly reflects the level of modernization in the education sector. What are the theoretical connotations of Chinese-style higher education modernization? How can a comprehensive indicator system for Chinese-style higher education modernization be constructed and measured? How should China, including the eastern, central, and western regions, advance Chinese-style higher education modernization? Research on these issues is crucial to building a strong education nation and realizing Chinese-style modernization.

2. Literature review

The concept of education modernization is notably marked by the U.S. Congress's passage of the National Defense Education Act in 1958. In China, education modernization became a public policy discourse beginning in 1983 with Deng Xiaoping's "Three Orientations." Research on Chinese-style higher education modernization primarily includes the following two aspects.

2.1. Studies on the connotation of Chinese-style higher education modernization

Research on the connotation of Chinese-style higher education modernization should proceed from

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two perspectives. First, the intrinsic aspect, which defines higher education modernization from the activities within higher education itself, using "modernity" to characterize it. Second, the external aspect, viewing higher education modernization as a component of China's overall societal modernization.

Chinese-style modernization and Chinese-style higher education modernization. The path to modernizing higher education is integral to the Chinese-style modernization route (Han, 2022[2]). The two are in a part-to-whole relationship; advancing Chinese-style higher education modernization requires understanding the inherent features of Chinese-style modernization (Wang and Xiao, 2022[3]). The national modernization strategy serves as both the primary driver and basis for defining the role of higher education modernization (Liu, 2020[4]). Chinese-style education modernization, as a "late-developing endogenous" form, derives its internal logic from the Party-led modernization efforts (Zhang and Yuan , 2022[5]).

Higher education modernity and modernization. Modernity is the concept, while modernization is the process. The concept typically precedes the process, which aims to achieve the concept's ideals. Higher education modernity is a fundamental, universal, and shared issue, whereas higher education modernization addresses surface-level concerns of modernity (Wang, 2020[6]). Educational modernity represents essential attributes that differentiate modern education from traditional education (Chu, 2018[7]). Achieving education modernization means gradually increasing modernity factors in education, reaching world-average levels, and eventually the level of developed nations (Hu and Wang, 2023[8]).

2.2. Studies on measuring Chinese-style higher education modernization

International social development indicators consistently include education as an essential component of modernization, encompassing elements such as cultural knowledge dissemination (Hall et al., 1965[9]), specialization within educational organizations (Levi, 1962[10]), school enrollment rates (Inkeles, 1985[11]). China's research on higher education modernization indicators dates back to the 1990s, with various developed regions formulating their frameworks, such as Guangdong (Liu, 1997[12]), Shanghai (Zhu, 2007[13]), and Jiangsu (Xu et al., 2010[14]). In recent years, as higher education modernization research has gained momentum, scholars have proposed several frameworks, primarily qualitative in focus. For instance, some suggest that evaluating education modernization requires examining both educational forms and modernity (Chu, 2013[15]); others assess it based on context, input, process, and product dimensions (Yang, 2014[16]; Zhong and Wei, 2020[17]). Other frameworks propose five dimensions, such as ideology and philosophy, for evaluating modernization in higher education (Cao and Wang, 2018[18]). A few empirical studies also exist. Examples include constructing a modernization indicator system for Tibet's higher education based on seven dimensions, evaluated through factor analysis (Yang et al., 2016), and using the entropy weighting method to measure China's education modernization level by examining seven dimensions, including educational input (Dai and Wang, 2022[19]). Recently, a three-dimensional scale—factors, capabilities, and functions—was constructed to measure the high-quality development of Chinese higher education using grey relational analysis and other methods (Huang and Ding, 2022[20]).

3. Connotation of Chinese-style higher education modernization

3.1. Modernization and education modernization

Modernization is a revolutionary, complex, systematic, global, long-term, phased, homogenizing, irreversible, and progressive process (Huntington, 1971[21]). It signifies a transformation from underdevelopment to development at national or regional levels, embodying economic, institutional, and governance aspects. Its metrics evolve with socio-economic advancements, making it a relative concept (Hu and Ning, 2021[22]).

Education modernization, as part of this process, progresses alongside societal modernization. It entails educational reform based on an advanced informational society, guided by modern educational concepts, and employs advanced information technology. This process represents a shift from traditional to modern education, characterized by democratization, equity, lifelong learning, and flexibility across time and space (Gu, 2012[23]).

3.2. Higher education modernization and Chinese-style higher education modernization

Higher education modernization, an essential component of education modernization, has entered the

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national modernization agenda, forming a foundational and catalytic role in national development. The primary question in higher education modernization is its relationship with societal and human modernization, positioning it to lead in these domains (Qu, 2017[24]).

From the perspective of goals and outcomes, Chinese-style higher education modernization aims to achieve comprehensive development for all people and shared spiritual prosperity. It is a modernization that promotes balanced progress in both material and spiritual civilization, centered on a people-oriented approach (Liu, 2022[25]).From a process perspective, Chinese-style higher education modernization represents an innovative process in educational theory. It is not Westernization, nor is it a full transplant of Western educational values, training models, and methods into China (Gao, 2021[26]).

4. Construction of the Chinese-style higher education modernization indicator system

4.1. Indicator system for Chinese-style higher education modernization

Table 1: Chinese-style higher education modernization evaluation indicator system based on CIPP.

Dimension	Secondary indicator	Tertiary indicator	Unit	Characteristic
Context	Enrollment opportunity	Number of general undergraduate and specialized enrollment	People	Equity and lifelong learning
		Number of graduate enrollments	People	
	Learning community construction	Number of correspondence and part-time graduates	People	
		Number of full-time graduates	People	
Input	Faculty resources	Number of Staff	People	Scientific and diverse
		Number of teaching staff	People	
	Infrastructure	Campus area	sq. meters	
		Green area	sq. meters	
		Sports area	sq. meters	
		Number of classrooms	Rooms	
	R&D conditions	Number of research and teaching staff	People	
		Number of books	10,000 volumes	
Process	Educational informatization	Value of information equipment assets	10,000 yuan	Informatization and internationalization
		Number of computers	Units	
		Number of multimedia classrooms	Rooms	
	Degree of internationalization	Number of foreign graduates	People	
		Number of enrolled international students	People	
	Talent development	Number of undergraduate and specialized students in school	People	
		Number of undergraduate and specialized degrees awarded	People	
	Faculty development	Number of full-time faculty with doctoral degrees	People	
		Number of full professors	People	
Product	Human capital	Number of undergraduate and specialized graduates	People	Productivity and creativity
		Number of graduate program graduates	People	
	Social contribution of education	Number of graduates with qualification certificate training	People	
		Number of graduates with job certificate training	People	

First, principles for construction. The indicator selection must balance ideal and practical aspects, focusing on its intended purpose. The selection should prioritize reliability, measurability, coverage of the research subject, relevance to the measured phenomenon, and inter-indicator relationships.

Second, structural dimensions. The system uses *China Education Modernization 2035* as a primary reference, incorporating eight core features of educational modernity (Gu, 2012) and follows the CIPP

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evaluation model (Stufflebeam,1967[27]). This model includes four dimensions—Context, Input, Process, and Product—to evaluate higher education modernization. The Context dimension represents the foundational indicators, Input focuses on resources for assessment, Process targets the implementation stages, and Product addresses the final outcomes of higher education modernization.

Third, indicator selection. The Context dimension includes two sub-dimensions: enrollment opportunity (aligned with equity and lifelong learning) and learning community construction. Input includes four sub-dimensions: faculty resources, infrastructure, and R&D conditions, aligning with scientific and diversity standards. The Process dimension includes four sub-dimensions: level of educational informatization, degree of internationalization, talent cultivation, and faculty development, aligned with informatization and internationalization. Finally, the Product dimension covers three sub-dimensions: human capital and social contribution of education, aligned with productivity and creativity. The resulting system consists of four dimensions, 13 sub-dimensions, and 26 specific indicators, enabling an analysis of the development of higher education modernization in China (see Table 1).

4.2. Measurement of Chinese-style higher education modernization level

This study uses the coefficient of variation method to determine the weight of each indicator, reflecting its relative importance within the system. Weighted averaging is applied to calculate the modernization levels across 31 Chinese provinces from 2010 to 2022 (excluding Hong Kong, Macau, and Taiwan due to data limitations). This measurement is a preliminary estimate due to substitute indicators and data source constraints. The specific calculation results are as follows:

First, all indicators are dimensionless to enable comparability by eliminating dimensional influences. Missing data were supplemented using linear interpolation when possible. All positive tertiary indicators were standardized and transformed to solve for scale issues, using the following formula:

$$x_i^* = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \tag{1}$$

where x_i^* is the standardized value, x_i is the original indicator value, and $x_{\max}$ and $x_{\min}$ are the maximum and minimum values for each variable. The dimensionless result falls between (0, 1).

Next, based on the standardized processing of tertiary indicators, use the predetermined weights of each indicator determined by the coefficient of variation method to synthesize the index through weighted summation. The calculation formulas for primary and secondary indicators are as follows:

$$Z_i = \sum_{i=1}^{n} x_i^* . w_i \tag{2}$$

where Z_i is the final result for each first or second-level indicator, x_i^* is the standardized result of each tertiary indicator, w_i is the weight of the tertiary indicator corresponding to x_i^*, and n is the number of tertiary indicators.

Finally, the overall formula for synthesizing the higher education modernization level is:

$$modern_i = \sum_{i=1}^{N} Z_i w_i \tag{3}$$

5. Level of Chinese-style higher education modernization

5.1. Average level of higher education modernization in provinces from 2010-2022

As can be seen from Table 2, Jiangsu Province achieved the highest overall score of 0.65, demonstrating outstanding performance, particularly in the "Input" (0.82) and "Process" (0.81) dimensions. Its Context (0.53) and Product (0.65) scores are also relatively high, reflecting sustained investment and strong outcomes in faculty quality, infrastructure, and educational digitalization.

Shandong Province scored an overall 0.61, with solid performance in "Input" (0.81) and "Process" (0.78). However, the Context score is 0.36, indicating room for improvement in educational access and

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the broader social learning environment.

Guangdong Province's overall score is 0.53, showing balanced performance, with a particularly high Product score of 0.72, underscoring strong educational outcomes. The Input score of 0.63 is slightly lower than those of Jiangsu and Shandong, yet Guangdong maintains a competitive edge in higher education output.

In summary, Jiangsu, Shandong, and Guangdong demonstrate high performance across dimensions, especially in "Input" and "Process," highlighting these regions' emphasis on educational resources and digitalization development.

Table 2: Average levels of higher education modernization in each province from 2010 to 2022.

Province	Context	Input	Process	Product	Overall
Jiangsu	0.53	0.82	0.81	0.65	0.65
Shandong	0.36	0.81	0.78	0.69	0.61
Guangdong	0.44	0.63	0.49	0.72	0.53
Henan	0.3	0.59	0.76	0.64	0.52
Sichuan	0.31	0.52	0.56	0.51	0.44
Hubei	0.28	0.58	0.58	0.49	0.44
Hunan	0.22	0.43	0.55	0.44	0.37
Beijing	0.66	0.27	0.37	0.24	0.36
Zhejiang	0.32	0.36	0.46	0.37	0.35
Hebei	0.19	0.38	0.47	0.47	0.35
Jiangxi	0.16	0.47	0.43	0.34	0.32
Liaoning	0.26	0.37	0.44	0.35	0.32
Anhui	0.17	0.4	0.45	0.38	0.32
Shanxi	0.27	0.31	0.42	0.37	0.31
Shanghai	0.36	0.22	0.28	0.2	0.25
Fujian	0.19	0.3	0.29	0.26	0.24
Chongqing	0.17	0.31	0.33	0.24	0.24
Heilongjiang	0.19	0.27	0.33	0.26	0.24
Guangxi	0.14	0.25	0.26	0.3	0.22
Yunnan	0.13	0.24	0.28	0.25	0.2
Jilin	0.17	0.21	0.22	0.23	0.19
Shanxi	0.11	0.16	0.3	0.25	0.18
Guizhou	0.1	0.23	0.31	0.18	0.18
Tianjin	0.15	0.18	0.17	0.16	0.15
Inner Mongolia	0.09	0.16	0.21	0.14	0.14
Xinjiang	0.07	0.22	0.19	0.11	0.13
Gansu	0.08	0.14	0.17	0.16	0.12
Hainan	0.03	0.06	0.06	0.06	0.05
Ningxia	0.04	0.06	0.07	0.04	0.05
Tibet	0.01	0	0	0.01	0.01
Qinghai	0.01	0.02	0.02	0.02	0.01

5.2. Average level of higher education modernization in eastern, central, and western regions (2010-2022)

Table 3 shows that the Input dimension had the highest national average score, emphasizing the importance of resource increases in education modernization. The eastern region scored highest overall, particularly in Input and Product, highlighting its advantages in faculty investment, R&D resources, and educational outcomes. The central region's scores were relatively high, especially in Input, indicating a steady increase in resource allocation. The western region scored the lowest overall, especially in Context and Product, suggesting areas for improvement in educational equity and outcome transformation.

These results underscore the regional disparities in higher education modernization, with the eastern region leading in resource investment and outcomes.

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Table 3: Average levels of higher education modernization in eastern, central, and western regions from 2010 to 2022.

	Context	Input	Process	Product	Overall
National	0.04	0.09	0.08	0.04	0.25
East	0.05	0.12	0.12	0.06	0.35
Central	0.04	0.10	0.07	0.04	0.25
West	0.02	0.06	0.04	0.02	0.15

6. Conclusion and Policy Recommendations

The modernization of higher education is a critical driver and foundation for advancing Chinese-style modernization. It is also a key indicator of a country's development level and potential. This study, based on the CIPP evaluation model, constructs a comprehensive assessment framework for higher education modernization in China. The framework includes four dimensions: context, input, process, and output, with 26 specific indicators. Using the coefficient of variation method, the study measures the level of higher education modernization across provinces and regions in eastern, central, and western China from 2010 to 2022. The results reveal significant disparities in the modernization process across regions and provinces.To promote higher education modernization and support Chinese-style modernization, this study proposes the following policy recommendations.

6.1. Optimizing strategic layout of higher education for new development

First, regional layout. Develop regional strategies based on economic, cultural, and social characteristics. The eastern coastal areas can focus on international and research-oriented universities, while the central and western regions should emphasize applied and vocational education. A resource-sharing mechanism should be established to promote collaboration and efficient distribution of quality educational resources within regions.

Second, tiered structure. Develop a multi-tiered higher education system based on social demand and talent training goals, covering undergraduate, junior college, and vocational education to meet diverse student needs and employment goals. Flexible pathways for talent development should encourage students to choose educational tracks based on personal interests and career goals, fostering individualized growth.

Third, diverse types of institutions. Encourage universities to align programs and courses with market demands, offering research-oriented, application-based, and vocational programs to meet various talent development needs. Promote school-enterprise collaboration to cultivate applied talents aligned with societal needs.

6.2. Encouraging eastern region higher education innovation to lead modernization

First, digital transformation. Build a digital education platform that integrates online courses, teaching resources, and learning management systems, facilitating information sharing and educational innovation. Introduce AI and big data technologies to enhance teaching quality and student engagement, creating personalized learning solutions that cater to diverse student needs. Regularly train teachers in digital skills to improve their adaptability and effectiveness in digital learning environments.

Second, development of educational content. Deepen curriculum reform across various disciplines, focusing on practical and innovative skills to enhance student competencies. Implement project-based learning (PBL), encouraging interdisciplinary research on real-world problems, improving student practical skills, and fostering teamwork. Integrate research outcomes into teaching content to enhance curriculum relevance and applicability.

Third, open and collaborative education. Establish strong industry-academia cooperation, jointly designing industry-relevant courses to boost student employability. Promote international collaboration, encouraging partnerships with overseas educational institutions to enhance global engagement. Strengthen collaboration and resource sharing among universities in the eastern region to address challenges and optimize resource allocation.

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6.3. Supporting central region higher education as a modernization accelerator

First, increased investment. Increase financial support from the government for central region higher education, particularly in infrastructure and research funding, to ensure high-quality educational resources. Encourage private investment in education, guiding businesses and organizations to provide scholarships and financial aid to reduce students' financial burdens.

Second, talent development structure. Optimize curriculum design to align with regional economic development needs, especially focusing on training applied and technical talents for emerging industries and the local economy. Strengthen school-enterprise collaboration to enhance students' practical skills and competitiveness.

Third, level of openness and sharing. Establish a regional education alliance to facilitate resource sharing among central region universities, improving efficiency in utilizing educational resources. Encourage international collaboration to introduce high-quality foreign educational resources and concepts, increasing the level of educational internationalization.

6.4. Ensuring steady progress in western region higher education as a modernization stronghold

First, policy support. Increase fiscal support from national and local governments for western region higher education, particularly in infrastructure and campus improvements to ensure a conducive learning environment. Establish dedicated funds to support innovative projects, research activities, and specialty programs to strengthen local universities. Implement preferential enrollment policies to attract top students and enhance competitiveness.

Second, education network services. Build an educational information platform for the western region to centralize services like admissions, course resources, and academic exchange, promoting resource sharing and usage. Expand online education offerings, particularly for remote areas, using digital technology to address gaps in educational resources. Use this platform for remote teacher training, academic discussions, and vocational education, enhancing flexibility and coverage.

Third, high-quality professional faculty. Develop a teacher recruitment policy to attract high-level talent and fill specialized faculty gaps in western universities. Provide regular training and professional development opportunities to improve teaching quality and address new educational needs. Establish a teacher exchange program between eastern and western universities to foster experience sharing and resource complementarity, enhancing overall teaching standards.

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