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Research Article

Research on the International Education Path for Chinese Standard Going Global

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Abstract

International education (IE) is duty-bound to achieve the world-leading Chinese standard. The Chinese standard going global requires IE to eliminate barriers and to cultivate a large number of international talents who understand and accept Chinese standards. To this end, the structure entropy weighting method combined with Delphi technique and Fuzzy decision analysis was applied in this paper to construct an international education evaluation index system for Chinese standard going global. The international education path of Chinese standards going global strategy was clearly explained from three aspects: developing language education, and consolidating the communication foundation; promoting cultural education, and gaining value recognition; enhancing professional education, and implementing standard promotion.

Keywords

Chinese Standards • International Education (IE) • Education Path

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In recent years, China has expedited implementing the “going global” strategy and promoting the Belt and Road initiative (BRI). In the process of trade and technical exchanges with other countries, the going-global paces of Chinese enterprises, engineering and technology have been stable indeed. According to the National Bureau of Statistics (NBS), in the short period of 2008-2016, China’s foreign contracted projects were carried out all over the world, and the total turnover increased from 56.6 billion US dollars to 159.4 billion US dollars, with an increase of nearly 3 times. As more Chinese enterprises go out together with Chinese projects, Chinese technology is driven to go out, and eventually the Chinese standards need to go out of China. It has been one new model for China’s development by using funds to develop technology and then promote the standards. International education is the core for the global recognition of Chinese standards (Sheldon, 2006; Wang & Meng, 2016).

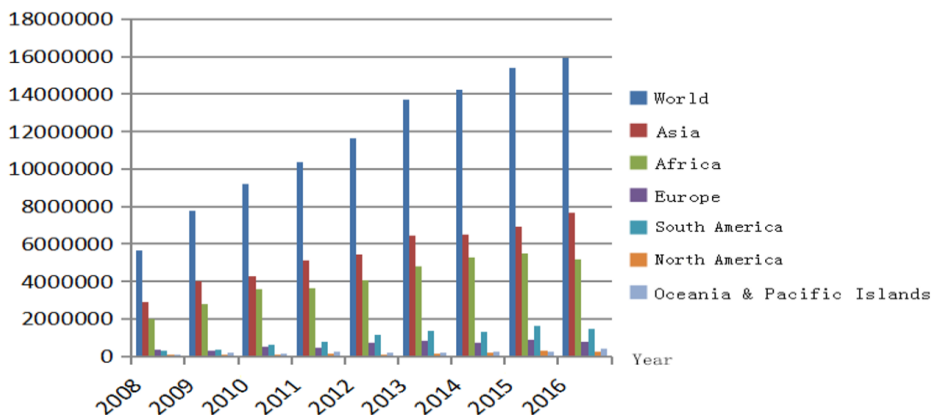


Figure 1. Total turnover of China’s contracted projects (US\$10,000) (NBS website data)

International education for Chinese standard going global

Chinese standards go out, which can be traced back to the Tanzania-Zambia railway that was built in the 1970s. Some overseas projects involving Chinese enterprises have been designed and constructed using Chinese standards. The Adama wind power project jointly organized by China Hydropower Engineering Consulting Group Co., Ltd. and CGC Overseas Construction Group Co., Ltd in Ethiopia is China’s first wind power project with globalized Chinese technology, standards, management and equipment. It is completely designed, constructed and accepted with Chinese standards.

The Chinese standard should be internationally valid, authoritative and credible. It is a “passport” for going global. The widespread adoption in the world is the key step in going global. At present, in the international environment, European and American standards are still prevalent, while the Chinese Standards have not been widely popularized due to the lack of education in the international arena. The owners of overseas projects are generally trained by western education, so they tend to adopt European and American standards. Besides, the

relevant English versions of Chinese standards that can be easily read by the international community have not yet been promoted on a large scale, and China's participation in international standardization is still relatively insufficient. These factors make the Chinese Standard not yet fully recognized by a certain country or region. It requires negotiations based on specific projects about whether the projects involved with Chinese technology and capital adopt Chinese standards. Due to language barriers, only some foreign employees in China's global enterprises can read Chinese standards, but it cannot last long to design, construct, operate and maintain the project in accordance with the Chinese standard system. In addition, most of China's external construction projects are in countries and regions with relatively backward production technologies, low industrial production levels, and weak construction of technical and technical personnel, which directly causes the problems such as insufficient talents and technical support etc., and further constrains the pace of Chinese standards going global.

International education is an integral part of today's global economic, cultural and political exchanges. American professor Callan (2000) believes that IE is equivalent to the internationalization of education. He believes that the internationalization of education should include not only the international exchange of courses, scholars and students, various cooperation programs with the community, training and extensive management services, but also clear endorsement, positive attitude, global awareness, going-global development direction and development scope (Wang, 2018). Chinese scholar, Yuan (2009) stated that IE is the overall feature and historical trend of education in the current era; it is not only a historical category, but also a concept of development. In the background of the problems faced by human beings and the competition globalization among countries, it aims to realize human internationalization. By taking diverse international exchanges and cooperation as the carrier, it is also the process of mutual learning, exchange and cooperation between different countries' educational concepts, educational methods, educational systems and educational models. IE is duty-bound to achieve the world-leading Chinese standard. The key to the Chinese standard going global is to eliminate barriers to popularization through education and to cultivate a large number of international talents who understand and recognize Chinese standards. On the one hand, the talent demands of the global enterprises should be satisfied for overseas Chinese-funded enterprises, so as to cultivate local technical talents who can master Chinese language, easy language communication, and understand and accept Chinese standards. On the other hand, through the integration of production and education, Chinese standards should be promoted overseas, and local talents who master Chinese standards for enterprises are cultivated, which is conducive to the coordinated development of production and social economy, and also the cultivation of Chinese culture and Chinese technology.

Chinese standard going global-oriented international education evaluation system

Chinese standard going global-oriented international education evaluation index system

The scientific and rationality of final evaluation result is determined by the index system. With reference to the domestic and foreign literatures, this paper constructs a multi-level international education evaluation index system related to the standard objectivity, integrity, hierarchy and comprehensiveness (Table 1).

Table 1
Chinese Standard Going Global-Oriented International Education Evaluation Index System

First-level indicators	Second-level indicators
Language education (u ₁)	Basic English and Chinese education (u ₁₁)
	Bilingual standard education (u ₁₂)
	Standard foreign language translation (u ₁₃)
	Bilingual standard translation platform construction (u ₁₄)
Cultural education (u ₂)	Expert exchange visits (u ₂₁)
	Grassroots friendly cooperation project (u ₂₂)
Professional education (u ₃)	Higher education foreign cooperation (u ₃₁)
	Vocational education external cooperation (u ₃₂)
	International exchange training in the industry (u ₃₃)

Structural entropy weighting method

In order to better rationalize the weight of each evaluation index and reduce the subjectivity and uncertainty of the previous weighting method, this paper introduces a “structural entropy method” that combines subjective with objective assignment method. That is, combined with Delphi Technique and Fuzzy Decision Analysis, through subjective evaluation by experts, horizontal comparison sort was performed about the importance of indicators according to the subjective experience of experts, and the structural entropy weighting method was used to performs objective assignment processing, so as to calculate the entropy value and the final value.

Forming “horizontal comparison sort” based on expert opinion. k experts were invited to participate in the Delphi method expert survey. The “horizontal comparison sort” on the importance of each index was performed. The index set is denoted as U={u₁, u₂, ...u_n}, and the evaluation set of its corresponding experts “horizontal comparison sorting” is denoted as A=(a_{ij})_{k*n}, i=1, 2, ..., k, j=1, 2, ..., n, a_{ij}, where, a_{ij} is the evaluation of the importance degree by the i-th expert for the j-th index u_j, and it takes any one of the natural numbers in {1, 2, ..., n}, as shown in Table 2.

Table 2
“Horizontal Comparison Sorting” list by Delphi Expert Survey

	u ₁	u ₂	u _n
Expert 1	a ₁₁	a ₁₂	a _{1n}
Expert 2	a ₂₁	a ₂₂	a _{2n}
.....
Expert k	a _{k1}	a _{k2}	a _{kn}

Eliminating the “horizontal comparison sort” noise data, and making qualitative and quantitative conversion according to the information entropy function formula. “Horizontal comparison sort” often has noise data that can lead to potential bias and uncertainty of traceable data. To eliminate its impact, it is necessary to conduct statistics, analysis and processing on the qualitative judgment conclusions of the indicators. That is, using the information entropy theory formula $x(I)=-\lambda p_n(I) \ln p_n(I)$, the entropy value is calculated to reduce the uncertainty of the expert “horizontal comparison sort”. The specific method is as follows:

Let $P_n(I)=(m-I)/(m-1)$, then take $1/(\ln(m-1))$

It's derived as:

$$x(I) = -\ln(m-1) \cdot ((m-I)/(m-1)) \cdot (I) \cdot \ln((m-I)/(m-1))$$

It's simplified as: $x(I) = (m-I) \ln(m-1) / (m-1) \ln(m-1) + (m-I) / (m-1)$

Dividing on both end $(m-I)/(m-1)$, and let $x(I)/(m-I)/(m-1) = \mu(I)$

Then $\mu(I) = \ln(m-I) / \ln(m-1)$

I is the number of sorts given by experts in "horizontal comparison sort" for certain indicator, $\mu(I)$ is the membership function value of I, and μ is the variable defined between [0, 1]. $I=1, 2, \dots, j, j+1, j$ is the actual maximum sequence number, and m is the conversion parameter quantity, taking $m=j+2$.

At $I=1$, $p_n(1) = (m-1)/(m-1) = 1$

At $I=j+1$, the maximum sequence number is taken, and then, $p_n(j+1) = ((j+2)-(j+1))/((j+2)-1) = 1/(j+1) > 0$

In the third step, the cognitive blindness analysis is performed on "horizontal comparison sort".

Substituting $I=a_{ij}$ into the equation $\mu(I) = \ln(m-I) / \ln(m-1)$, the conversion value b_{ij} of a_{ij} quantitative can be obtained, and $b_{ij} = \mu(a_{ij})$ is the membership degree of I. The membership matrix is $B = (b_{ij})_{k \times n}$.

Calculate the consensus view of all the experts on the index μ_j , which is called the average awareness, denoted as b_j .

$$b_j = (b_{1j} + b_{2j} + \dots + b_{kj}) / k$$

Define the uncertainty of the i-th expert's cognition for the index μ_j , which is called "cognitive blindness", denoted as Q_j .

$$Q_j = (|\max(b_{1j} + b_{2j} + \dots + b_{kj}) - b_j| + |\min(b_{1j} + b_{2j} + \dots + b_{kj}) - b_j|) / 2, Q_j \geq 0$$

Define the overall recognition of the k experts for each indicator μ_j , X_j , $X_j = b_j(1 - Q_j)$, $X_j > 0$.

In the fourth step, the μ_j is normalized.

It's assumed that $W_j = X_j / \sum X_j$, $W_j (i=1, \dots, m; j=1, \dots, n) > 0$ and $\sum W_j = 1 (j=1, \dots, n)$. $W = \{w_1, w_2, \dots, w_n\}$ is called the weight vector of the index set $U = \{u_1, u_2, \dots, u_n\}$, that is, the overall judgment of k experts for the importance of index sets $U = \{u_1, u_2, \dots, u_n\}$ is consistent with the willingness or cognition of the expert community.

Chinese standard Going Global-oriented Structure entropy weighting of international education evaluation index

In this paper, 16 experts were selected for consultation. These experts include experienced education experts, specializing in language education, intercultural education, higher education, vocational and technical education, etc., and also technical and management personnel of overseas Chinese enterprises. According to the consultation results, the index system "horizontal comparison sort" were scored, which was converted into index weights by the structural entropy weighting method. Then, all the scoring lists were processed, to obtain the structural entropy of the international education evaluation indicators (Table 3).

Table 3
Chinese standard Going Global-oriented Structure Entropy Weighting of International Education Evaluation Index

		First-level index and weight		Second-level index and weight	
		First-level index	Weight	Second-level index	Weight
Chinese standard Going Global-oriented international education evaluation index	Language education (u ₁)	0.3308	Basic English and Chinese education (u ₁₁)	0.2571	
			Bilingual standard education (u ₁₂)	0.2432	
			Standard foreign language translation (u ₁₃)	0.2685	
			Bilingual standard translation platform construction (u ₁₄)	0.2312	
	Cultural education (u ₂)	0.3279	Expert exchange visits (u ₂₁)	0.4859	
			Grassroots friendly cooperation project (u ₂₂)	0.5141	
	Professional education (u ₃)	0.3413	Higher education foreign cooperation (u ₃₁)	0.2846	
			Vocational education external cooperation (u ₃₂)	0.4019	
			International exchange training in the industry (u ₃₃)	0.3135	

Chinese standard going global-oriented international educational path

Developing language education and consolidating communication foundation

(1) Relying on the Confucius Institute, the Chinese and English language general education and standardizing basic knowledge can be popularized among foreign students in China. Language barrier is one of the major reasons that Chinese enterprises are difficult to promote “China Standards” overseas. Overseas owners do not understand Chinese, not to mention understanding the Chinese standard. Therefore, the promotion of Chinese standards first requires the popularization of Chinese language. The Confucius Institute is an important institution for Chinese language education and popularization in the world. As of 2017, there are 516 Confucius Institutes and 1,076 Confucius Classrooms covering 142 countries and regions around the world. Among them, 135 Confucius Institutes and 130 Confucius Classrooms are located in 51 countries along the Belt and Road. The role of the Confucius Institute in the training of talents is: completing the Chinese language pre-university education for foreign students, breaking the language barriers and laying the foundation for education in China; cultivating the comprehensive talents who understand the local technology, Chinese and local culture. For this, the advantages of the Confucius Institute can be fully utilized, by opening pre-university classes for foreign students, basic/high school Chinese language classes, and in-service Chinese language training classes, and providing targeted courses for different groups of people, which shall help to promote Chinese standards and build standardized systematic Chinese education training mechanism (Wang and Zhang, 2018).

(2) Standard international translation talents should be cultivated, and a bilingual translation platform for Chinese standards should also be established. In practice, overseas owners need to conduct benchmarking before

using Chinese standards, and translation work bears the brunt. However, in non-English speaking countries, the translation problems and language quality problems exist in the translation process of national standards. The experts of Standard internationalization ever tried to overcome these problems through various methods (De Vries, 1999; Sheldon, 2006). Combining China's national conditions, standard bilingual education should be carried out to cultivate professional standard translation talents. Besides, with the development of authoritative bilingual standard corpus standards and international intelligent cloud translation platform tools, it has been conducive to improving the accuracy of Chinese standard foreign language translation. Eliminating language barriers can effectively promote the participation in the standard internationalization work and drive the Chinese standards to go global.

Developing cultural education and gaining value identification

(1) While introducing Chinese culture to foreigners, Chinese standardization knowledge should be also integrated, i.e., introducing Chinese technology through Chinese standards, and then China's national conditions and culture. The concepts of modesty, benevolence and non-hegemony advocated in Chinese culture are generally accepted by the world. Especially in the promotion process of the "Belt and Road", China's attitude of coordinated development has been supported by countries along the route, and these countries have actively carried out cooperation with various fields in China. In this context, there is an urgent need for a large number of skilled personnel who understand international industry standards and Chinese culture. Thus, in these countries, it starts the upsurge of learning Chinese. The government and the public publicize China's educational resources, laying a good foundation for them to take short-term training and vocational skills in China.

(2) Scientific and powerful institutional and legal guarantees should be provided for the smooth development of education internationalization. In many western developed countries, the government is an important promoter of education development. The *Fulbright Act* and the *National Education Law* issued by the US government provide guarantees for the healthy and stable development of American education. The British government has ensured the reform and improvement of the scholarship system by laws and regulations. The French government formulated the Erasmus Plan. A series of experiences have shown that governments at all levels in China need to realize the importance of their own in promoting the internationalization of education, actively fulfil their duties and exercise their power, and maximize their macro guidance and coordination. Through IE, the cultural output is promoted, to enhance the identity sense of Chinese culture value and thus recognize Chinese standards.

Developing professional education and implementing standard promotion

(1) A standardized education and training system should be established to recruit overseas students. At present, China's standardization talent training is limited to several courses in China's Metrology Institute and several other universities. The technical courses in common universities do not teach standardization knowledge, since it's not included in the Chinese national education knowledge system (Cheng, 2010). The Chinese standard "going global is still in the preliminary exploration stage. In response to this situation, with

the joint effort of domestic and foreign industry, a complete training system covering the bachelor, masters, doctor, and post-doctoral studies should be constructed as soon as possible. It's necessary to carry out education of academic qualifications and non-academic qualifications, and appropriately accept overseas students who can systematically study Chinese standards. Foreign advanced experience can also be learnt, e.g., the Japanese Industrial Standards Committee introduces standardized training programs to elementary schools, junior high schools, high schools and colleges, so that students can understand the role of standardization in daily life; Tokyo University of Science, Waseda University etc. have established standardization major and course; the Ministry of Economy, Trade and Industry in Japan regularly holds international standardization education training courses, introduces the status quo of international standardization work, international standard formulating procedures and rules, and trains international standardization professionals.

(2) International technical cooperation and academic exchanges should be carried out widely. For countries that have not yet established a standard system, relevant personnel should be invited in China to inspect various engineering projects designed, constructed and maintained according to Chinese standards, and understand the standard cases with Chinese technology. Besides, standardized training should be provided to introduce standardization knowledge and international standardization status etc. China's standardization agencies abroad can also hold various standardization seminars, trainings and other activities for training the foreign stakeholders to understand Chinese standards, use Chinese standards, and finally adopt Chinese standards.

(3) The "foreign apprentices" should be cultivated to build a talent training mechanism for vocational education. Vocational education is an important cornerstone for Chinese Standards landing overseas. The vocational colleges should carry out in-depth cooperation with local governments, enterprises and institutions overseas by focusing on certain industry, exploring joint schools or overseas schools, and cultivating skilled talents on the spot, which can practically promote the overseas practice of Chinese standards going global. Higher vocational education should cooperate with the national Belt and Road initiative to help high-quality production capacity go out and expand vocational education cooperation

with countries along the "Belt and Road". It should also actively explore and serve the needs of "going out" enterprises, to cultivate technical talents with international vision being familiar with international rules and also the local talents meeting the overseas production and management needs of Chinese enterprises (*Higher Vocational Education Innovation Development Action Plan (2015-2018)*). Higher vocational colleges have training equipment and places that are not available in undergraduate colleges, and the theory and practice are integrated in the teaching process; through ordered classes training and modern apprenticeships development, it makes the joint operation with large-scale enterprises in international business, and integrates the industrial processes, manufacturing processes, product standards, technical standards and service standards required by the industry into the teaching process in consideration of the education characteristics in vocational education, so as to jointly build the international talents training base. This shall help the "going out" enterprise to conduct short-term technical skills training and academic vocational education for localized employees. The school-enterprise cooperation under the integration of production and education in the new era is an important carrier to promote the Chinese standard going global. For example, Tianjin has been exploring the development of quality vocational education. Since 2016, it has officially established four Luban workshops in Thailand, the United Kingdom, India and Indonesia. Luban Workshop is an innovative professional education

internationalization service project that cooperates with international production capacity and cultivates technical talents who are familiar with Chinese technology, understand Chinese crafts, and recognize Chinese products. Taking the Luban Workshop in India as an example, the first two internationalization professions have been approved by the Indian education administration. India's "Luban Workshop" has signed a student order training agreement with five large Chinese-funded enterprises in India, so as to jointly cultivate local talents who are familiar with Chinese technology, products and standards urgently needed by enterprises. Thus, with the integration of production and education, it is conducive to promoting the coordinated development of production and social economy, and also the cultivation of corporate culture and Chinese standards by promoting Chinese standards overseas and training local talents who master Chinese standards for enterprises.

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