

# Research on the Effect of Labor Education in Universities based on CIPP Model

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**Abstract:** ***Objective:** To measure the effectiveness of labor education in universities, classify students into different groups and further improve the effectiveness of labor education. **Methods:** This paper establishes a four-index evaluation system of labor education in colleges and universities based on the CIPP model, and uses the entropy weight method to determine the index weight, so that the four indicators established by the CIPP model can be calculated. The specific scores of the indicators, and the investigation of the colleges and universities that are implementing labor education in Hebei Province, according to the data to calculate the specific scores, and then use the K-means algorithm to cluster analysis to classify the specific majors according to the characteristics of their scores, specifically and comprehensively explore the effect of labor education in colleges and universities. **Conclusions:** most of the majors are in high-performance majors, and the rest are basically in medium-performance majors. Only a few majors are low-performance. This phenomenon shows that China's labor education system is healthy, which plays a role in promoting the construction of a strong education country and the cultivation of talents.*

**Keywords:** Labor education; CIPP model; Entropy weight method; K-means algorithm.

## 1. INTRODUCTION

Since the 18th National Congress of the Communist Party of China, the Party Central Committee has attached great importance to labor education in colleges and universities, and has successively issued policy documents on labor education, identifying labor education as an important part of the entire education system. In March 2020, the Central Committee of the Communist Party of China and the State Council issued the "Opinions on Comprehensively Strengthening Labor Education in Colleges, Secondary and Primary Schools in the New Era," which clearly put forward the comprehensive construction of a labor education system that reflects the characteristics of the times.

As an important part of the whole education system, labor education can be used as the embodiment of Marxist labor view and labor values in education. At the same time, the new era requires the adjustment and reform of the talent training mode according to the new needs of social development. Because labor education has made great contributions to the construction and exploration of socialist modernization in China, it has provided a batch of high-quality talents. Therefore, it is of great theoretical and practical significance for us to comprehensively promote quality education and accelerate the completion of the shortcomings of labor education, which is of great theoretical and practical significance for building a strong education country and cultivating new people in the era of national rejuvenation.

## 2. LITERATURE REVIEW

At present, scholars have carried out various studies on the evaluation system of labor education, which are mainly divided into two aspects: theoretical model establishment and hierarchical analysis. On the one hand, Zheng Guoping et al. (2023) [1] constructed a theoretical labor education evaluation system based on the characteristics of university labor education. On the other hand, Cai Ruilin et al. (2023) [2] used Saaty's fuzzy comprehensive index method to empower its evaluation indicators after constructing the theoretical labor education evaluation system, which made the indicators within the labor education evaluation system form a certain degree of attention. Finally, Cheng Jiafu et al. (2024) [3] and Zhou Lei et al. (2023) [4] used the expert's scoring of the indicators to further assign weights to the comprehensive evaluation of the labor education system through the analytic hierarchy process, so that it can be quantified.

However, most of the CIPP-based labor education research now only stays on the surface of the research, and lacks further research induction, so that it is only theoretical and lacks certain practicality. This paper uses the evaluation model of labor education system established by CIPP model to evaluate the survey data. Taking different majors of

colleges and universities as the main body, the entropy weight method is used to calculate the scores, and the cluster analysis is used to obtain the classification and induction. The clustering results are used to give full play to the effect of CIPP model on labor education evaluation system.

### **3. RESEARCH METHOD**

#### **3.1 The Construction of the Effect System of Labor Education in Colleges and Universities based on CIPP Model**

Based on the CIPP model, choose a series of indicators to evaluate the effect of labor education in colleges and universities. Firstly, the evaluation of labor education in colleges and universities is divided into four main indicators, and then the influencing factors are determined.

Background evaluation index: used to measure the basis of the development of labor education in colleges and universities, including the environmental basis of colleges and universities, students' needs and talent training objectives. The environmental basis of a university is the internal and external environment and overall guarantee of the labor education in colleges and universities, and it is the premise of evaluating the effect of labor education in colleges and universities. When evaluating the environmental basis, need to pay attention to education policy, social environment and school environment. Demand is the driving force of progress. In the evaluation of the effect of labor education, must grasp the needs of students for labor activities. When evaluating students' needs, need to pay attention to students' willingness to participate, students' intrinsic motivation to participate, students' extrinsic motivation to participate and students' social motivation to participate. The goal of talent training is the direction of labor education in colleges and universities, and it is the core. When evaluating the goal of talent training, need to pay attention to the importance of decision-making management, the clarity of training objectives and the accuracy of target implementation.

Input evaluation index: It is used to measure the input of labor education in colleges and universities, including curriculum system, teacher input, fund input and site facilities. The curriculum system can directly reflect the content and degree of labor education received by students. When evaluating the curriculum system, it is necessary to pay attention to the curriculum setting, curriculum distribution and curriculum rationality. Excellent teachers are the key factors of the quality of labor education in colleges and universities. When evaluating the input of teachers, need to pay attention to full-time teachers, external teachers, the number of teachers and the ratio of double teachers. Funding investment is an important guarantee for labor education in colleges and universities. When evaluating funding investment, it is necessary to pay attention to the proportion of school special funds investment, campus labor culture construction, labor education teacher training and other expenses. As an important material basis for labor education in colleges and universities, site facilities need to pay attention to the quantity and quality of site facilities, the frequency and efficiency of site use, and the maintenance and management of site when evaluating site facilities.

Process evaluation indicators: It is used to test the operation mechanism of labor education in colleges and universities, including the content of labor education organization, the implementation of labor education practice and the supervision of labor education management. The content of labor education organization is organization management, system formulation and operation, and resource integration. The implementation of labor education practice can directly reflect the implementation in the actual operation of labor education. When evaluating the implementation of labor education practice, it is necessary to pay attention to the design and arrangement of teaching activities, teachers' teaching methods and methods, and students' participation. The supervision of labor education management pays attention to the management and supervision of labor education, which can ensure the smooth operation and continuous improvement of labor education. When evaluating the supervision of labor education management, should pay attention to the monitoring and evaluation of the teaching process, the training and guidance of teachers, and the implementation and management mechanism of the curriculum.

Outcome evaluation index: It is used to measure the performance of labor education and training talents in colleges and universities, including the improvement of students' labor literacy, the improvement of teachers' labor education ability and the promotion of school labor education achievements. The improvement of students' labor literacy is an important goal of labor education, which includes labor values, labor emotional quality, labor knowledge and skills, labor practice and habits, and students' labor skills identification. Excellent teachers are the key factors of the quality of labor education in colleges and universities. The improvement of teachers' labor education ability includes teachers' labor literacy, teachers' labor education consciousness and teachers' labor

education ability. The promotion of labor education achievements is also an effective standard to evaluate the implementation of labor education, which mainly includes the sharing of labor education resources, the concept and top-level design of labor education, the typical cases of labor education and the social response of labor education.

By optimizing the top-level design, refining and improving the evaluation index system, the research explores and innovates on the basis of the existing research results, and constructs the evaluation system of labor education effect in colleges and universities, which not only lays a foundation for the construction of the optimal evaluation index system, but also provides a decision-making basis for educators to evaluate labor education scientifically and reasonably, and provides a scientific basis for the calculation of the weight of evaluation index based on entropy weight method.

### 3.2 Weight Calculation of Evaluation Index based on Entropy Weight Method

The basic idea of the entropy weight method is to calculate the objective weight according to the variability of the index. Generally speaking, the smaller the information entropy of the index, the greater the degree of variation and the greater the weight. On the contrary, the greater the information entropy of the index, the smaller the degree of variation. The smaller the role in the comprehensive evaluation, the smaller the weight. On the basis of the CIPP index evaluation system established above, use the entropy weight method to calculate the weight of each index of labor education effect in colleges and universities.

The subjects of this study are mainly students who are carrying out labor education in Hebei Province, mainly in the first and second grades. The survey mainly includes six aspects: students' basic situation, students' attitude, school top-level design, atmosphere construction, teaching staff and condition guarantee. In this study, online questionnaires were distributed through the questionnaire star platform, and a total of 1145 questionnaires were collected. After eliminating the questionnaires with missing information, 1137 valid questionnaires were obtained, with an effective rate of 99.3 %.

Step 1: Select all the indicators of the university as the basic panel data, take the number of students  $n = 1137$  and the number of indicators  $m = 42$ , and use  $x_{ij}$  to represent the value of the  $j$  indicator of the  $i$  sample ( $i = 1, 2, \dots, n$ ;  $j = 1, 2, \dots, m$ ), they form a matrix as follows:

$$X = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{31} & x_{32} & \cdots & x_{nm} \end{pmatrix} \quad (1)$$

Step 2: Need to standardize the original indicators. Different types of indicators need to be standardized in different ways:

$$y_{ij} = \begin{cases} \frac{x_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)}, & \text{if } X_j \text{ is the positive indicator.} \\ \frac{\max(X_j) - x_{ij}}{\max(X_j) - \min(X_m)}, & \text{if } X_j \text{ is the negative indicator,} \end{cases} \quad (2)$$

The original index matrix  $\{X_1, X_2, \dots, X_m\}$  is standardized and converted into a standardized index matrix  $\{Y_1, Y_2, \dots, Y_m\}$ ,  $y_{ij}$  represents the value of the  $j$ th index of the standardized  $i$ -th sample:

$$X = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{31} & x_{32} & \cdots & x_{nm} \end{pmatrix} \text{Standardize} \Rightarrow Y = \begin{pmatrix} y_{11} & y_{12} & \cdots & y_{1m} \\ y_{21} & y_{22} & \cdots & y_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ y_{31} & y_{32} & \cdots & y_{nm} \end{pmatrix} \quad (3)$$

Step 3: uses the standardized value to calculate the proportion of the  $i$ th sample in the  $j$  index, and  $p_{ij}$  is the proportion of the  $i$ th sample in the  $j$  index.

$$p_{ij} = \frac{y_{ij}}{\sum_i y_{ij}}, i = 1, 2, \dots, n; j = 1, 2, \dots, m \quad (4)$$

Step 4: Calculate the information entropy to calculate the entropy value of index  $j$ :

$$E_j = -\frac{1}{\ln(n)} \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (5)$$

Where n is the number of samples, in general,

$$0 \leq E_j \leq 1$$

Step 5: According to the information entropy obtained in step 4, the information entropy of each index is:

$$E_1, E_2, \dots, E_m$$

By calculating the information redundancy  $D_j$ , and then calculating the index weight value according to the information redundancy:

$$D_j = 1 - E_j \Rightarrow W_j = \frac{D_j}{\sum D_j} (j = 1, 2, \dots, m) \quad (6)$$

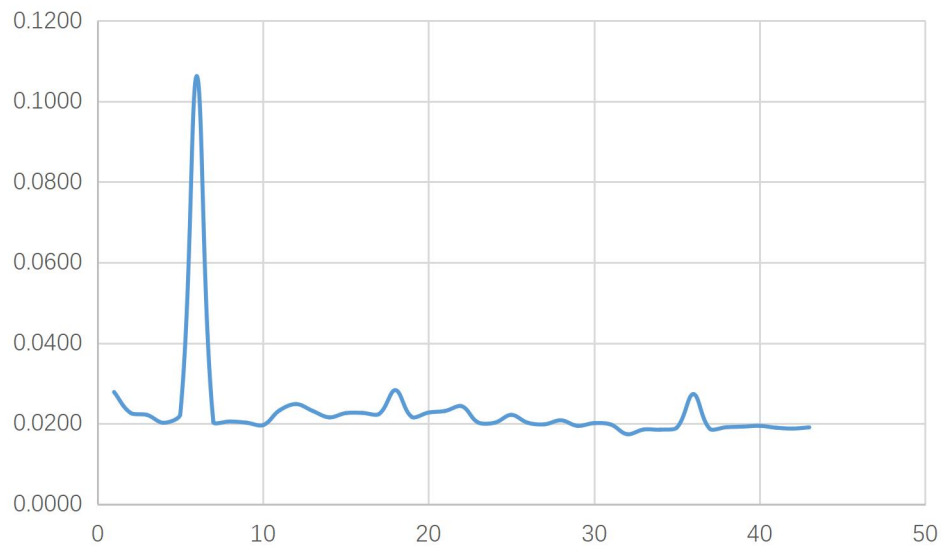


Figure 1: The weight of each index

Step 6: Calculate the scores of the original data according to the obtained weight value:

$$Score_{ij} = \sum_{j=1}^m W_j \cdot x_{ij} (i = 1, 2, \dots, n) \quad (7)$$

The weight of the whole index system is sorted into table 1.

Table 1: CIPP index system and weight

second index	average	third grade indexes	average	four-level indicators	
context evaluation	0.2891	environment foundation	0.0580	①educational policy	0.0278
				②social environment	0.0227
				③school environment	0.0222
		students' needs	0.1665	①Students' willingness to participate	0.0202
				②Students' intrinsic motivation to participate	0.0223
				③Students' participation in external motivation	0.1063
				④Students' participation in social motivation	0.0204
		talents training objective	0.0646	①The importance of decision-making management	0.0205
				②The clarity of training objectives	0.0202
				③Accuracy of target execution	0.0196
input evaluation	0.2094	curriculum system	0.0454	①curriculum provision	0.0233
				②course distribution	0.0249
				③Curriculum rationality	0.0232
		Teacher input	0.0532	①full-time teacher	0.0216

				②External teachers	0.0226
				③Number of teachers	0.0227
				④Double teacher ratio of teachers	0.0224
		fund input	0.0471	①School special funds investment	0.0283
				②The proportion of campus labor culture construction, labor education teacher training and other expenses	0.0216
		site facilities	0.0638	①Quantity and Quality of Facilities	0.0227
				②Frequency and efficiency of use of the site	0.0231
				③Maintenance and management of the site	0.0243
		process evaluation	0.2868	The content of labor education organization	0.1344
②System formulation and operation	0.0202				
③Integration degree of resources	0.0222				
The implementation of labor education practice	0.0577			①The design and arrangement of teaching activities	0.0202
				②Teachers' teaching methods and methods	0.0198
				③Participation of students	0.0208
Labor education management supervision	0.0946			①Monitor and evaluate the teaching process	0.0195
				②Training and guidance for teachers	0.0201
				③Curriculum implementation and management mechanism	0.0198
assessment of results	0.2147	The improvement of students' labor literacy	0.1019	①labor values	0.0174
				②Labor emotional quality	0.0185
				③Labor Knowledge and Skills	0.0185
				④Labor practice and habits	0.0190
				⑤Identification of students' labor skills	0.0273
		The improvement of teachers' labor education ability	0.0422	①Teachers' labor literacy	0.0187
				②Teachers' consciousness of labor education	0.0191
				③Teachers' labor education ability	0.0193
		The promotion of school labor education achievements	0.0706	①Labor education resource sharing	0.0195
				②Labor education concept and top-level design	0.0190
				③Typical cases of labor education	0.0188
				④Social repercussions of labor education	0.0191

### 3.3 Cluster Analysis Model and Result Analysis

According to the score calculated by the entropy weight method, the clustering method is used to divide the clustering clusters of each specialty. After that, each cluster is analyzed in detail.

From a statistical point of view, clustering analysis is a method to simplify and structure data. Here, the more commonly used K-means clustering algorithm is selected for cluster analysis.

By classifying the students of the same major, the average scores of background evaluation, input evaluation, process evaluation and result evaluation of the effect of labor education in colleges and universities are obtained. Then, the evaluation score vector  $L^{(i)}$  is clustered and analyzed. The evaluation score vector is defined as

$$L^{(i)} = \{L_{i1}, L_{i2}, L_{i3}, L_{i4}\}$$

Among them,  $L_{i1}$  is the average score of background evaluation,  $L_{i2}$  is the average score of input evaluation,  $L_{i3}$  is the average score of process evaluation, and  $L_{i4}$  is the average score of result evaluation.  $m$  is the number of samples, that is, the number of majors, and the sample set is

$$\{L^{(1)}, \dots, L^{(m)}\}$$

$$L^{(i)} \in \mathbb{R}^4$$

Step 1: Randomly select  $K$  cluster centers as

$$\mu_1, \mu_2, \dots, \mu_k \in \mathbb{R}^4$$

K is the number of clusters given. In fact, after many attempts, K = 4 is selected as the value of K, that is, the number of clusters is 4.

Step 2: Repeat the following process until convergence.

1) For each sample i, calculate the class it should belong to.

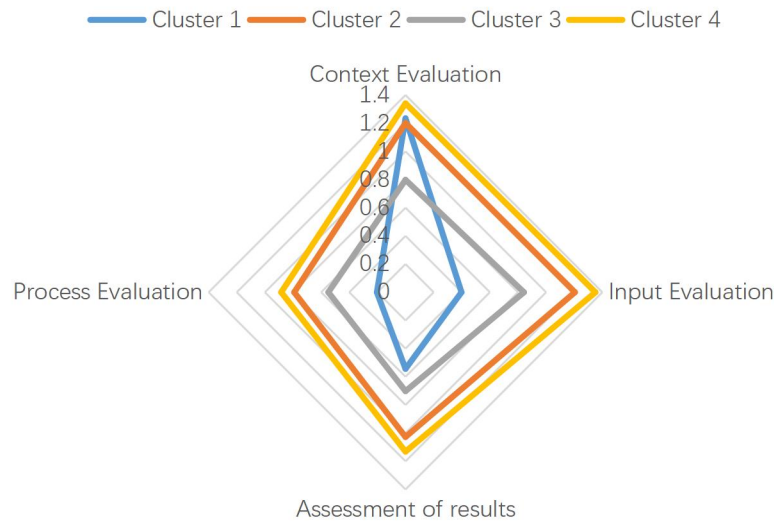
$$c^{(i)} = \arg \min_j ||L^{(i)} - \mu_j||^2. \quad (8)$$

$c^{(i)}$  represents the nearest class between sample i and K classes, So the value of  $c^{(i)}$  is in the range of 1 ~ k.

2) For each class j, recalculate the cluster center of this class.

$$\mu_j = \frac{\sum_{i=1}^m 1_{\{c^{(i)}=j\}} L^{(i)}}{\sum_{i=1}^m 1_{\{c^{(i)}=j\}}}. \quad (9)$$

That is to say, the average value of all sample coordinates is calculated, and the process of 1) and 2) is repeated until convergence. The radar map distribution of the clustering results is drawn here:



**Figure 2:** Radar distribution of clustering results

From the clustering results, it can be seen that the shape of three clusters in the four clusters is basically the same, and it can be seen that the distribution of the four evaluations is relatively balanced, and the shape of the remaining last cluster is relatively singular compared with the other three clusters, which is classified as unbalanced specialty. The results of clustering are sorted into table 2.

**Table 2:** Classification of majors type of different types of students

Type	Majors
High-performance majors	Measurement and control technology and instruments, vehicle engineering, urban and rural planning, electrical engineering and automation, electronic information science and technology, animal medicine, landscape architecture, business management, industrial design, international economy and trade, Chinese language and literature, chemistry, environmental science and engineering, mechanical and electrical engineering, mechanical design and manufacturing and automation, control engineering, tourism management, wood science and engineering, agricultural electrification and automation, agricultural resources and environment, software engineering, forest protection, biological engineering, biotechnology, food science and engineering, food quality and safety, land resource management, civil engineering, foreign language and literature, applied chemistry, English, gardens, horticulture, seed science and engineering.
Middle performance major	Financial management, law, public management, accounting, computer science and technology, finance, economic statistics, economics, history, forestry, agricultural and forestry economic management, agricultural mechanization engineering, Japanese, ecology, biological science, pharmacy, plant protection, pharmaceutical engineering, intelligent agriculture, Chinese medicine.
Low performance	traditional chinese veterinary medicine



major  
Unbalanced  
specialty

traditional chinese medicine

High-performance majors: High-performance majors mainly include engineering, literature, information science, natural science, food science, and agriculture. Science and engineering majors account for the majority, and only a small number of liberal arts majors. By observing the clustering results, because it presents a huge background and investment scale. Therefore, these majors have produced better process evaluation and outcome evaluation. It can be seen that the performance of high-performance majors in background, input, process and achievement has reached the best, and the advantages are very obvious. These advantages may be due to the popularity of the major and the strength of the school.

Middle performance major: Middle performance major is mainly represented by economics, law, computer, social science, agriculture and forestry engineering. Liberal arts account for the majority, only a small part of the engineering profession. By observing the clustering results, it can be found that although all aspects of the performance profession are only about 0.2 less than the high-performance profession, these professions also have certain advantages.

Low performance major: only one of the low performance majors is Chinese veterinary medicine, which obviously shows that the school may pay less attention to this major. Maybe it is because the popularity of this major is far less than other majors or the society's demand for this major is lower than other majors. As a result, students and schools do not pay attention to this major.

Unbalanced specialty: There is only one unbalanced specialty for traditional Chinese medicine. By observing the radar map of Figure 3, it can be found that the background evaluation of traditional Chinese medicine specialty performs very well, but it performs poorly in other aspects. It shows that its performance in environmental foundation, students' needs and talent training objectives is better, but it is very poor in other aspects. It is specifically explained that the major may have attracted the attention of schools and students, but due to some reasons, the investment scale is relatively small, which may directly lead to poor performance of process and result evaluation.

#### 4. CONCLUSION

Develop a healthy and effective labor education system. It is of great significance for building a strong education country and cultivating talents. Therefore, this paper investigates the students who are carrying out labor education in Hebei Province, collects the corresponding data of their students, and establishes the evaluation system of labor education from four aspects: background evaluation, process evaluation, input evaluation and result evaluation through CIPP model. After that, the entropy weight method is used to calculate the weight, and different professions are scored and ranked. According to the scores of labor education in different majors, through cluster analysis, they are divided into four categories: high-performance majors, medium-performance majors, low-performance majors and unbalanced majors.

According to the analysis, most of the majors are in high-performance majors, and the rest are basically in medium-performance majors. Only a few majors are low-performance. This phenomenon shows that China's labor education system is healthy, which plays a role in promoting the construction of a strong education country and the cultivation of talents.

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