Advances in Applied Sciences
2021; 6(4): 84-87
http://www.sciencepublishinggroup.com/j/aas
doi: 10.11648/j.aas.20210604.13
ISSN: 2575-2065 (Print); ISSN: 2575-1514 (Online)

Application of Analytic Hierarchy Process in Classification Assessment of Professional Labor Education Curriculums

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To cite this article:
Meng Yanhua, Zhang Renfu, Wang Qiquan. Application of Analytic Hierarchy Process in Classification Assessment of Professional Labor Education Curriculums. *Advances in Applied Sciences.* Vol. 6, No. 4, 2021, pp. 84-87. doi: 10.11648/j.aas.20210604.13

Received: August 28, 2021; **Accepted**: September 16, 2021; **Published**: October 16, 2021

Abstract: At present, China is attaching importance to the issue of labor education for students, upgrading the traditional "four education" to "five education", that is, adding labor education on the basis of morality, intelligence, physical education and beauty. The relevant colleges and universities in China are exploring how to carry out the teaching of vocational labor education. As a relevant university in the labor field, the school where the author works is also actively exploring various issues concerning professional labor education, including exploring the curriculum setting of professional labor education, the proportion of class hours of relevant courses, the content of relevant courses, and how to carry out professional intercommunication teaching with relevant majors. This paper systematically divides the professional labor education curriculums obtained from the conference and discussion held by the relevant professors in the author's school, it means that the professional labor education curriculums are graded. Then by adopting the combination of qualitative and quantitative analytic hierarchy process (AHP) combined with multiple expert assessment of classifying labor education curriculum evaluation and determine the weight of each course in the professional labor education courses. So as to determine the importance of professional labor education courses for professional labor education teaching, to provide theoretical support for the development of professional labor education courses in the country. At the same time, it also provides technical support for introducing professional labor education into safety engineering teaching. Through the research of this paper, it is found that the application course of professional labor education is the most important part of professional labor education curriculum, and the setting of such courses should be strengthened. Simultaneously, the thoughts of labor and thought, labor and law, labor and safety, labor and economy in professional labor education courses can be introduced into the teaching of safety engineering courses.

Keywords: Analytic Hierarchy Process, Professional Labor Education Curriculum, Evaluation

1. Introduction

According to *the Report on the Development of China's National Mental Health (2019-2020*), by the end of 2020, about 20 percent of Chinese people were suffering from mental illness, 30 to 40 percent of which were caused by excessive labor pressure. [1] When viewed at the national level, China is in a period of rapid development, the pace of the overall society is relatively fast, and people generally have more labor pressure and labor problems. From the perspective of the workers themselves, most of the current workers are relatively deficient in professional labor ability, which leads to the majority of people do not know how to protect their physical and mental health in the process of labor. [2, 3] In order to solve these problems, China has decided to strengthen the labor education of college students, raising labor education to the level of "four education" (moral, intellectual, physical education, aesthetic education). Relying on it to build a modern scientific labor education system, strengthen the contemporary college students labor education of new tasks and new topics, so as to form and improve a higher level of talent training system, to achieve the fundamental goal of "cultivate people through virtue". [4]

China is currently exploring the setting of professional labor education courses. The professional labor education courses discussed by relevant professors in the author's university include the following courses: Labor science and life, labor thought, labor ethics and culture, Labor and society

(labor union), labor and safety, labor and management, labor and law, Labor and promotion (labor model class), labor and social security, the future of labor, labor and labor relations, labor and psychology, labor and economy, 13 courses in all. In order to determine the importance of each course, this paper uses analytic hierarchy process to analyze. The analytic hierarchy process (AHP) can make qualitative and quantitative analysis of this kind of complex decision-making problems. By comparing factors at different levels, the influence of subjective factors can be greatly reduced in the evaluation, which provides technical basis for scientific analysis of the importance of each course and the allocation of credit hours. [5]

2. The Establishment of Mathematical Models

This paper adopts analytic hierarchy process (AHP) to establish the model. The analytic hierarchy process (AHP) can form a hierarchical model according to the influencing factors and internal relations of the problem. It can use a small amount of data to analyze the structural characteristics of the whole process, and conduct a unified qualitative and quantitative analysis of the whole problem, so as to provide a relatively simple method for solving complex decision-making problems. [6]

2.1. Identify Indicators of All Levels

After investigation and analysis, professional labor education curriculums are divided into three first level indicators: professional education basic curriculum, professional education application curriculum, professional education specialized curriculum. The first level indicators are further divided into a number of secondary level indicators, and the secondary level indicators are the courses established by professional labor education. [8, 9] The indicators are divided mainly according to the existing majors and the design of professional courses, among which the professional education basic curriculum teach students the thought of labor and establish correct labor values. The professional education application curriculum is mainly divided according to the application situation, and the content of such courses can be applied to labor practice. The professional education specialized curriculum are mainly divided in accordance with the professional, master these courses will master the professional knowledge in the field of labor, which lays a foundation for students to further study in the field of labor research. The professional education basic curriculum include labor science and life, labor thought, labor ethics and culture, labor and society (labor union); the professional education application curriculum include labor and safety, labor and management, labor and law, labor and promotion (labor model class); the professional education specialized curriculum include labor and labor relations, labor and psychology, the future of labor, labor and social security, labor and economy.

2.2. Expert Evaluation

Three experts were asked to rate the study. Analytic hierarchy process (AHP) will be used to determine the weight of indicators, and the judgment matrix S will be obtained by 1~9 scaling method. [10, 11] The specific scoring rules are shown in Table 1:

Table 1. *Grading schedule.*

a_{ij}=1	F_i and F_j are equally important
a_{ij}=3	F_i is slightly more important than F_j
a_{ij}=5	F_i is obviously more important than F_j
a_{ij}=7	F_i is much more important than F_j
a_{ij}=9	F_i is extremely more important than F_j
Note: If in between, rank it by 2, 4, 6, 8	

2.3. The Analytic Hierarchy Process Determines the Weight

2.3.1. Identify Objectives and Evaluation Factors

P evaluation indicators,

$$u=\left\{u_1,u_2,\cdots\cdots,u_p\right\}$$

2.3.2. Constructing Judgment Matrix

The judgment matrix is obtained by comparing the index of each layer and the index of the upper layer in the hierarchical structure: [7]

$$S=\left(u_{ij}\right)_{p\times p}=\begin{bmatrix}u_{11} & \cdots & u_{1n}\\ \vdots & \ddots & \vdots\\ u_{n1} & \cdots & u_{nn}\end{bmatrix}$$

2.3.3. Calculating Judgment Matrix

DPS software is used to calculate the maximum feature root $\lambda_{\max}$ of the judgment matrix S and its corresponding feature vector A, which is the order of importance of each evaluation factor, that is, the distribution of weight coefficients.

2.3.4. Consistency Check

The single order of different factors in the same level is used to calculate the results, and then the weight of the elements in the upper level is calculated, and the weight distribution of the relative importance of all elements is formed and its consistency is tested. Firstly, the consistency index $CI=\frac{\lambda_{\max}-n}{n-1}$ and the mean random consistency index RI

should be calculated. [12] Then the consistency index values CI are calculated for each random sample matrix, and the mean random consistency index values RI are obtained for these values CI. When the consistency value of total ranking is $R = \frac{CI}{RI} < 0.10$, the results of hierarchical total weight ranking can be considered to have reasonable consistency. Otherwise, it is necessary to adjust the element values of the judgment matrix and reassign the value of the weight coefficient or let experts make a new judgment. [13] The corresponding relationship is shown in Table 2.

Table 2. *The standard values of the mean random consistency index RI.*

matrix dimension	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

2.4. Weight Distribution of Various Factors

Analytic hierarchy process (AHP) is used to determine the weight of indicators by comparing the importance of indicators at different levels and using 1~9 scaling method to get the judgment matrix S_i. Taking the main factors as an example, according to the opinion of an expert, the index system is established from three factors: professional education basic curriculum (u_1), professional education application curriculum (u_2) and professional education specialized curriculum (u_3). Construct the judgment matrix S_i:

$$S_1=\begin{bmatrix} 1 & 1/9 & 1/3 \\ 9 & 1 & 5 \\ 3 & 1/5 & 1 \end{bmatrix}$$

Matlab software is used to calculate the maximum characteristic root λ_{max} of the judgment matrix S_1: λ_{max} = 3.0291.

Consistency test of judgment matrix:

First, the consistency index needs to be calculated:

$$\text{C.I.}= \frac{\lambda_{max}-n}{n-1} = \frac{3.0291-3}{3-1} = 0.0146$$

When n = 3, R.I.= 0.52, C.R.= $CR = \frac{C.I.}{R.I.}$ = 0.0281<0.10.

Therefore, the result of the judgment matrix passes the consistency test and its weight value can be used. [14]

The eigenvectors corresponding to the judgment matrix are:

$$\overline{W}_1 = (0.0704, 0.7514, 0.1782)$$

The calculation results are summarized as shown in Table 3.

Table 3. *Main factor weight calculation results.*

Judgment Matrix S_1	u_1	u_2	u_3	$\overline{W}_1$	λ_{max}	$\frac{C.I.}{C.R.}$
u_1	1	1/9	1/3	0.0704		
u_2	9	1	5	0.7514	3.0291	0.0281<0.1
u_3	3	1/5	1	0.1782		

This calculation result can only represent the weight set given by one expert. By integrating the weight values of the three experts, the weight values of the main factors identified in Table 4 can be obtained. By analogy, the weight values of sub-factors affecting basic courses, applied courses and professional courses of professional education are calculated. [15]

Table 4. *Classification and weight of professional labor education curriculum.*

	The first level indicators	The secondary level indicators	weight
Classification of professional labor education curriculums	Professional education basic curriculum (0.0963)	Labor science and life	0.2814
		Labor thought	0.5034
		Labor ethics and culture	0.1293
	Professional education application curriculum (0.6859)	Labor and society (labor union)	0.0859
		Labor and safety	0.3053
		Labor and management	0.1261
		Labor and law	0.5030
		Labor and promotion (labor model class)	0.0656
	Professional education specialized curriculum (0.2178)	Labor and social security	0.1182
		The future of labor	0.0464
		Labor and labor relations	0.0650
		Labor and psychology	0.2391
		Labor and economy	0.5313

3. Conclusion

The analytic hierarchy process (AHP) is used to divide the elements into multiple hierarchical indexes, which can be used for qualitative and quantitative analysis of multiple indexes. According to the importance ranking analysis of first level indicators, the professional education application

curriculum is the most important of professional labor education curriculum, and the number of hours and total amount of such curriculum should be increased. Labor and thought, labor and law, labor and safety, labor and economy and other courses account for a high proportion from the analysis of secondary index weight, and these courses should be set as professional core courses. The application of analytic hierarchy process to the classification evaluation of professional labor education curriculums can make the evaluation process more comprehensive, systematic, scientific and accurate. By optimizing the content of professional labor education curriculums, allocating teaching hours reasonably and focusing on the key points of teaching, students can lay a good academic foundation for mastering professional labor education knowledge.

Simultaneously, according to the evaluation of professional labor education courses by analytic hierarchy process, the main ideas of courses with high weight in professional labor education courses can be introduced into the professional courses related to safety engineering For example, labor and law can be introduced into the course teaching of safety occupational regulations, and labor and economy can be introduced into the course teaching of safety economics, so as to achieve the effect of professional intercommunication. In this way, students can master the core knowledge of professional labor education while mastering the professional knowledge of safety, so that students can better carry out labor protection and safety management for workers in the future work.

Acknowledgements

This paper is supported by general project of China University of Labor Relations (20XYJS026).

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