Training Evaluation of Vocational Qualification for the Skilled Talents Based on AHP

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Abstract. Aiming at uncertainty and complexity of training evaluation in vocational qualification for the skilled talents, the paper introduced a index system that applied The Analytic Hierarchy Process (AHP) to establish the evaluation model, the problem of construction, weight selection and satisfying consistency of judgment matrix is discussed. By means of the examples the students' ability are evaluated, meanwhile the feasibility of the proposed method applying process decision making is verified.

Introduction

Skilled talent refers to the front line in the field of production and service, mastering of expertise and technology, with superb operational skills, and in practice can solve key technical and process operational problems of personnel. Skilled talent, including skilled workers in the professional qualifications of technicians and senior technicians, mainly located in the first, second and tertiary industries in the high-skilled jobs, is an important part of our talent and the industry's Outstanding representatives [1].

Vocational qualification is a basic requirement for the knowledge, skills and abilities necessary to engage in a profession. Vocational qualification certificate is the national recognition of the applicant's professional (type of work) knowledge, technology, ability, which is the main basis for job, service, independent business and unit recruitment, also is an important content of the labor employment system. Vocational qualification is also a strategic measurement for the development of human resources in China, which is a special government examination, and it is also an internationally recognized qualification system for technical personnel.

Application-oriented undergraduate colleges and higher vocational schools bear the important task of cultivating skilled talents, and how to evaluate their abilities according to the standards of vocational qualification certificates has important guiding significance.

This paper constructs the ability evaluation index system by combining with the training evaluation of the vocational qualification certificate of the skilled talents, and establishes the evaluation model of the technical talents by using Analytic Hierarchy Process (AHP), and verifies the feasibility of the method through concrete examples[2].

Training Evaluation Index System

The vocational skills examination can reflect the comprehensive technical ability of the operator and reform the evaluation mechanism in the existing evaluation system. According to the national examination and training standard of vocational skill appraisal, the evaluation system of vocational skills training should be established with the target layer, the criteria layer and the index layer[3] .

There are lots of factors affecting Professional qualification training Practical evaluation. Generally, the main factors include factors of the technique, operation performance and professional accomplishment. The AHP method made by Satty is suitable for solving issues of general assessment with multiple targets and principles. The hierarchy structure of assessment in CNC milling examination is made per figure 1.

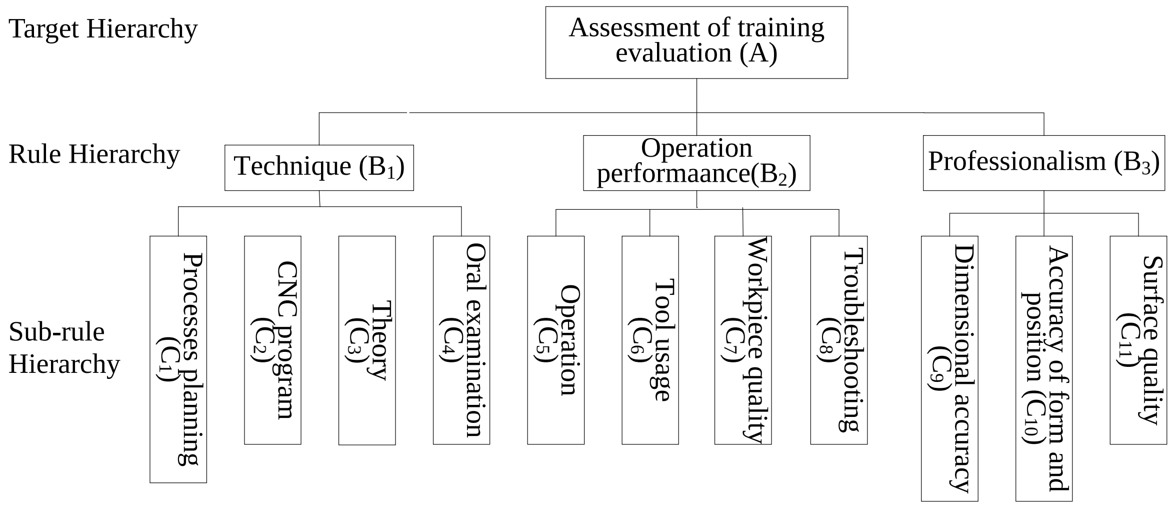

Fig.1. Hierarchy model of Professional qualification training Practical evaluation

Ability Evaluation Based on AHP

Comparing the index factors of the same layer, the judgment matrix of each layer is constructed by using the proportional scale of Table 1[4] [5].

Table 1. Scale of relative importance

Scale (a_{ij})	Definition
1	*i* is as important as *j* slightly
3	*i* is more important than *j* a little
5	*i* is more important than *j* obviously
7	*i* is more important than *j* thoroughly
9	*i* is more important than *j* wondrously
2，4，6，8	the medians of above judgment
the reciprocal of the above values	if the importance ratio of *i* and *j* is a_{ij}, the importance ratio of *j* and *i* is $1/a_{ij}$

After compared the significance level of each evaluating criteria (in table 1) , estimation matrix has formed：

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \tag{1}$$

Where $a_{ij} > 0$, $a_{ij} = \frac{1}{a_{ji}}, a_{ii} = 1 \quad i, j = 1,2,...,n$.

$$W_i = \sqrt[n]{\left(\prod_{j=1}^{n} a_{ij}\right)} \tag{2}$$

$$W_i^0 = W_i / (\sum_{j=1}^{n} W_j) \tag{3}$$

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\lambda_i \tag{4}$$

$$\lambda_i = (\sum_{j=1}^{n} a_{ij} W_j) / W_i \tag{5}$$

Where *W* is the characteristic vector of estimation matrix, $\lambda_{\max}$ is the maximum characteristic root of the estimation matrix, *n* is the rank of estimation matrix.

Table 2. RI parameter

Rank	3	4	5	6	7	8	9	10
RI	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

The rate of random consistence can be obtained as:

$$CR = CI / RI \quad (6)$$

$$CI = (\lambda_{\max} - n)/(n-1) \quad (7)$$

Where *CI* is the consistent index, *RI* is the index of average random coincidence in table 2.

When *CR*≤0.1, the estimation matrix has satisfied consistence. If not, modification is needed.

The set of evaluation factor is A={A1,A2,…,Am}，the evaluation set is V={v1,v2,…,vn}，Aiw is the Judgment object influence factor, vi is the object To be evaluated, R: $A \times V \to [0,1]$, $\tilde{R} = (r_{ij})_{m\times n}$, the weigh of assessment is $\tilde{W} = (w_1, w_2, ..., w_m)$, Fuzzy comprehensive evaluation set is as shows:

$$\tilde{Y} = \tilde{W} \oplus \tilde{R} = (w_i)_m \oplus (r_{ij})_{m\times n} = (y_1, y_2, ..., y_n) \quad (8)$$

The evaluation index can be divided into two categories: quantitative index and qualitative index. The qualitative index is scaled by proportional method. First, the evaluation index is divided into grades, and then the n experts are judged. Finally, the frequency belongs to each grade as the membership degree.

For the quantitative indicators using the membership function to determine membership, the dimensions of the indicators are not uniform or non-quantitative, there is no comparable, we must establish a unified measurement scale. The maximum-minimum method was adopted to determine the membership degree of each index:

$$\mu_{\tilde{R}i}(v_i) = r_i = \begin{cases} 0 & v_i \in [0, v_{\min,i}] \\ \dfrac{v_i - v_{\min,i}}{v_{\max,i} - v_{\min,i}} & v_i \in [v_{\min,i}, v_{\max,i}] \\ 1 & Others \end{cases}$$

Test results

The expert decide the weights for each objective with integral-valued 1-9 scale, the matrix are formed as follows in table 3 and table 4.

Table 3. Estimation matrixes and calculated parameters at all levels

A	B_1	B_2	B_3	w_i	w_i^0	λ_i	λ_{max}=3.054
B_1	1	2	2	1.587	0.493	3.054	CI=0.027
B_2	0.5	1	2	1	0.311	3.054	RI=0.52
B_3	0.5	0.5	1	0.63	0.196	3.053	CR=0.052

a)

B_1	C_1	C_2	C_3	C_4	w_i	w_i^0	λ_i	λ
C_1	1	5	6	7	3.807	0.631	4.27	CI=0.074
C_2	0.2	1	3	4	1.245	0.206	4.24	RI=0.89
C_3	0.167	0.333	1	3	0.651	0.108	4.13	CR=0.083
C_4	0.143	0.25	0.333	1	0.331	0.055	4.24	

b)

B_2	C_5	C_6	C_7	C_8	w_i	w_i^0	λ_i	λ
C_5	1	3	5	9	3.409	0.605	4.007	CI=0
C_6	0.333	1	2	3	1.189	0.211	4.016	RI=0.89
C_7	0.2	0.5	1	2	0.669	0.119	4.016	CR=0
C_8	0.111	0.333	0.5	1	0.371	0.065	3.110	

c)

Table 4. Estimation matrixes and calculated parameters at all levels

B_3	C_9	C_{10}	C_{11}	w_i	w_i^0	λ_i	λ_{max}=3
C_9	1	2	2	1.587	0.5	3	CI=0
C_{10}	0.5	1	1	0.794	0.225	3	RI=0.52
C_{11}	0.5	1	1	0.794	0.225	3	CR=0

a)

	B_1	B_2	B_3	CI_T	CR_T	W_i
	0.493	0.311	0.196			
C_1	0.631			0.074	0.083	0.311
C_2	0.206					0.102
C_3	0.108					0.053
C_4	0.055					0.027
C_5		0.605		0	0	0.188
C_6		0.211				0.066
C_7		0.119				0.037
C_8		0.065				0.020
C_9			0.5	0	0	0.098
C_{10}			0.225			0.044
C_{11}			0.225			0.044

b)

The weight w is:

$w=\left(0.311,0.102,0.053,0.027,0.188,0.066,0.037,0.020,0.098,0.044,0.044\right)$, CI_T=0.036, RI_T=0.817, CR_T=0.044<0.1， the estimation matrix has satisfied consistence.

The set of assessment V=（excellent，good，fine，poor），the excellent is V1=[85,100]，the good is V2=[75,85)，the average is V3=[60,75) ,the poor is V4=[0,60) . The weight matrix of each index are shown as：

$$R_1=\begin{pmatrix} 0 & 0.1 & 0.8 & 0 \\ 0 & 0.3 & 0.6 & 0 \\ 0 & 0.2 & 0.7 & 0 \\ 0 & 0 & 0.7 & 0.2 \end{pmatrix}$$

$$R_2=\begin{pmatrix} 0 & 0.3 & 0.6 & 0 \\ 0 & 0 & 0.8 & 0.1 \\ 0 & 0.1 & 0.7 & 0.1 \\ 0 & 0.1 & 0.6 & 0.2 \end{pmatrix}$$

$$R_3=\begin{pmatrix} 0 & 0.2 & 0.7 & 0 \\ 1 & 0.1 & 0.5 & 0.1 \\ 0 & 0.2 & 0.6 & 0.1 \end{pmatrix}$$

9 experts on a student's assessment score are shown as in Table 5.

Table 5. Expert evaluation data

Value	excellent	good	average	poor	weight
C_1	0	1	8	0	0.311
C_2	0	3	6	0	0.102
C_3	0	2	7	0	0.053
C_4	0	0	7	2	0.027
C_5	0	3	6	0	0.188
C_6	0	0	8	1	0.066
C_7	0	1	7	1	0.037
C_8	0	1	6	2	0.020
C_9	0	2	7	0	0.098
C_{10}	1	1	5	1	0.044
C_{11}	0	2	6	1	0.044

$B_1 = W_1 \times R_1 = (0 \quad 0.0723 \quad 0.366 \quad 0.0054)$, $B_2 = (0,0.0621,0.2035,0.0143)$, $B_3 = (0.044,0.0328,0.117,0.0088)$.

$$R = \begin{pmatrix} 0 & 0.0723 & 0.366 & 0.0054 \\ 0 & 0.0621 & 0.2035 & 0.0143 \\ 0.044 & 0.0328 & 0.117 & 0.0088 \end{pmatrix}$$

The assessment value $A = W \cdot R = (0.493,0.311,0.196)R = (0.008624,0.0613858,0.2666585,0.0088343)$, the simplified valve is $A = (0.02,0.18,0.77,0.03)$, from the point of result, the probability being excellent is 0.02, expressed as a percentile: A=95×0.02+80×0.18+70×0.77+55×0.03=71.85,the result of assessment is average.

Conclusion

This paper establishes the model of vocational qualification evaluation of skilled talents, and combines qualitative analysis and quantitative analysis with AHP and fuzzy mathematics. It analyzes the evaluation of the ability index system and provides information for the teaching feedback of vocational skills training. Teaching reform provides a basis.

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