



Study on the Higher Vocational Mode Combining Production with Learning and Research Based on AHP

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Abstract

In this article, we applied the AHP method with quantitative analysis and qualitative analysis to analyze three sorts of basic educational mode combining production with learning and research, i.e. the automated instruction, the mode combining production and learning, and the integration combining production with learning and research, and obtained that the educational mode combining production with learning and research was the optimal mode to realize the value of the higher vocational education.

Keywords: AHP, Combining production with learning and research, Mode

For the problem how to better carry through the education policy of CPC, make the higher vocational education develop healthily and realize the values of the higher vocational education, people mainly pay more attention to the educational mode combining production with learning and research. Because most scholars adopts the qualitative method to study the problem combining production with learning and research, we use the AHP method to analyze the relation between the educational mode combining production with learning and research and the realization of higher vocational education from the view of the combination of qualitative analysis and quantitative analysis, and expect providing more scientific references to select exact mode for the integration combining production with learning and research for high vocational education.

The analytic hierarchy process (AHP) was proposed by the US operational research expert, Profess T.L. Saaty of Pittsburgh University in 1970s, and he first utilized AHP to study the "Emergency Plan" for United States Department of Defense, and at present, the application and theory of AHP have been developed and perfected continually. The basic principle of AHP is the ordering, i.e. ordering various methods (or measures) and taking them as the reference of the decision-making. Its character is to combine the qualitative analysis and quantitative analysis, and give expression to human subjective judgment by the quantitative form, and implement scientific process. Therefore, AHP is more suitable for the complex domain of social science, and it can more exactly reflect the problems in the social science domain.

1. To establish the hierarchical structure

First, the combination of production, learning and research is a sort of educational mode, and it is a sort of approach. And its final aim is to realize the values of the higher vocational education, which is the objective layer A.

Second, the higher class character and the occupational character of the higher vocational education decide the values of the higher vocational education are mainly embodied in three aspects such as the cultivation value, the economic value and the social value, and these three aspects are the rule layer B. The talent cultivation value of the higher vocational education is mainly represented in the higher class character and the occupational character, and the economic value is mainly represented in that it can offer larger numbers of excellent talents to make contributions for the society through the scientific and technological innovation, and the social value is mainly represented in that the occupation training can increase the opportunities for citizens to accept the education, achieve the justice of the education through the popularization of the higher education, and these six points are the rule layer C.

Finally, no matter what the form combining production with learning and research is, and as a sort of operation mode of the education, the education combining production with learning and research can be mainly divided into three sorts of basic mode from the practical main bodies, i.e. the independent mode by the colleges, the cooperation mode by the colleges and enterprises, and the cooperation mode by the colleges, enterprises and scientific research institutes (i.e. the automated instruction, the mode combining production and learning, and the integration combining production with learning and research). In these three sorts of basic mode, the problem which one mode is the optimal mode to realize the values of the higher vocational education is the project layer D which should be solved through the decision-making.

Through confirming the factors on various layers and their positions and connecting the relations among them, the hierarchical structure can be established (see Figure 1).

2. To establish the judgment matrix and ask experts to fill in it

The filled judgment matrix is $A=(a_{ij})_{n \times n}$, and it possesses following characters.

$$(1) a_{ij} > 0$$

$$(2) a_{ij} = 1/a_{ji}$$

$$(3) a_{ii} = 1$$

For the special situation, the judgment matrix can possess the transitivity, i.e. it fulfills the equation $a_{ij} \cdot a_{jk} = a_{ik}$.

When the above equation exists for all factors in the judgment matrix, we call the judgment matrix as the consistency matrix.

The expert group includes 20 members such as the teaching managers, the teaching personnel, the scientific research personnel, the enterprise personnel, the government personnel and so on. Through the paired comparison for factors on each layer in the hierarchical matrix (seen in Figure 1) and endowing values for the importance degrees according to Table 1, the judgment matrix table can be composed (seen in Table 2).

3. Single layer ordering and test

The single ordering means to confirming the corresponding weights for various factors in each judgment matrix aiming at their own rule, and we adopt the sum method to compute the weights.

In the layer-layer ordering, we should implement the consistency test for the judgment matrix, and only the judgment matrix passes the test, it is reasonable in logic, and we can continue to analyze its results.

The consistency test includes following approaches.

First, compute the consistency index C.I.

$$C.I. = (\lambda_{\max} - n) / (n - 1)$$

Second, check the table and confirm the corresponding average random consistency index R.I.

According to the different orders of the judgment matrix, check the table and we can obtain the average random consistency index R.I. (seen in Table 3).

Third, compute the consistency ratio C.R. and judge.

$$C.R. = C.I. / R.I.$$

When $C.R. < 0.1$, we think the consistency of the judgment matrix can be accepted, and when $C.R. > 0.1$, we think the judgment matrix doesn't accord with the requirements, and we need to remodify the judgment matrix.

According to the above method, the single hierarchical ordering and the test results are seen in Table 4.

For all single orderings, $C.R. < 0.1$, so we think the consistency of each judgment matrix can be accepted.

4. Total layer ordering and test

The total ordering means to confirm the relative weights of various factors in the judgment matrix aiming at the objective layer (the top layer). For the computation of the weights, we adopt the method from top to bottom and integrate the weights layer by layer.

Obviously, the single ordering result of the second layer is the result of the total ordering. The total ordering of the factors on the K 'th layer for the total objective is $W^{(K)} = (W_1^{(K-1)}, W_2^{(K)}, \dots, W_n^{(K)}) = P^{(K)} W^{(K-1)}$.

We also need implementing the consistency test for the result of the total ordering. $C.I. = C.I.^{(K)} / R.I.^{(K)}$.

When $C.I.^{(K)} < 0.1$, we think the integrated consistency of the judgment matrix can be accepted.

According to above method, the total layer ordering and the test result are seen in Table 5 and Table 6.

For the total ordering, $C.R. < 0.1$, and we think the integrated consistency of the judgment matrix can be accepted.

5. Analysis of the results

Through analyzing the ordering results, we can obtain the final decision-making project.

From the ordering results of the rule layer B, we can see that the weight of the economic value (B2) is the lowest weight (0.1304), the weight of the social benefit (B3) is little high (0.2174), and the weight of the talent cultivation is the highest weight (0.6522). So, for the decision-making, we should emphasize the value of talent cultivation and the social value, and require little the economic value of the higher vocational college. The first task of the higher vocational education is to provide large numbers of vocational talents with high skills for the society. The main measure to serve

the society is to increase the employment, which will make lower directly economic contribution for the society, and that also indicates the correctness of the educational concept of the higher vocational education which takes the employment as the direction, takes the service as the tenet and takes the talent cultivation as the core.

For the single ordering result of the rule layer C, we can see that for the talent cultivation value (B1), the weight of the vocational skill (C2) (0.7500) is much bigger than the weight of the higher class (C1) (0.2500), and for the economic value (B2), the weight of offering talents (C3) (0.8333) is much bigger than the weight of the scientific technical innovation (C4) (0.1667), and for the social value (B3), the weight of increasing employment (C5) (0.8333) is much bigger than the weight of education justice (0.1667).

For the total ordering result of rule layer C, we can see that the weight of the vocational technology (C2) is the highest weight (0.4892) which is far bigger than the weights of other factors, and the weight of increasing employment (C5) (0.1812) takes second place, and the weight of higher class (C1) (0.1631) takes third place, and the weight of education justice (C6) (0.0362) takes fourth place, and the weight of the scientific technology innovation (C4) (0.0217) takes the final place.

The coherence of the single ordering result and the total ordering result on the rule layer C further demonstrates the status, the character, the cultivation objective and the talent standard from scientific view. The higher vocational education possesses double attributes of the higher education and the vocational education, and it is not only the higher stage of the vocational education, but also the important part of the higher education. Its fundamental task is to cultivate the application talents with higher technology, and its aim is to fulfill the demands for the middle and higher application technical talents in the first lines such as the social production, the management and the service. It takes the cultivation of the technical application ability as the main line to make students become the special talents with certain basic theoretical and professional knowledge, basic skills in the professional domain, and good vocational morality. And it is a sort of higher education type which can run through the whole process of the individual vocational development (Yi, 2005, P.10-14).

According to the single ordering result of the rule layer C, we can review and compare the differences of three modes in realizing the values of the higher vocational education. For the concrete factors, if we only consider the higher class of the talent cultivation, and the realization of the education justice and talent input to the society, three modes are almost same, and if we mainly consider the cultivation of students' vocational skills, increasing employment and scientific technology innovation, the integration combining production with learning and research is the optimal mode, and the cooperation by the college and enterprise takes the second place. And the education mode of the automated instruction is hard to realize the cultivation aim of the higher vocational education.

From the total ordering result of the project layer, we can see that the weight of the integration combining production with learning and research (D3) (0.5313) is far bigger than the weight of the cooperation by the college and enterprise (D2) (0.3413) which is much bigger than the weight of the automated instruction (D3) (0.1277). So the optimal mode to realize the value of the higher vocational education is the integration combining production with learning and research, and the cooperation by the college and enterprise takes the second place, and the mode of automated instruction can hardly realize the value of the higher vocational education.

To sum up, whether from the concrete factors or from the total ordering of the project layer to study three sorts of basic mode, the results are completely same, which further proves that in these three sorts of basic mode, the integration combining production with learning and research is the optimal mode to realize the values of the higher vocational education.

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Table 1. Meanings of the importance scales

Importance scale	Meanings
1	Two factors are same important
3	In two factors, the former factor is little important than the latter one
5	In two factors, the former factor is obviously important than the latter one
7	In two factors, the former factor is intensely important than the latter one
9	In two factors, the former factor is extremely important than the latter one
2, 4, 6, 8	The medians of above judgments
Reciprocal	If the importance ratio of the factor i with the factor j is a_{ij} , and the importance ratio of the factor i and the factor j is $a_{ji}=1/a_{ij}$

Table 2. Judgment matrix

A	B1	B2	B3		B1	C1	C2		B2	C3	C4		B3	C5	C6
B1	1	5	3		C1	1	1/3		C3	1	5		C5	1	5
B2	1/5	1	2		C2	3	1		C4	1/5	1		C6	1/5	1
B3	1/3	1/2	1												
C1	D1	D2	D3		C2	D1	D2	D3		C3	D2	D2	D3		
D1	1	1/2	1/3		D1	1	1/3	1/5		D1	1	1/2	1/3		
D2	2	1	2		D2	3	1	2		D2	2	1	2		
D3	3	1/2	1		D3	5	1/2	1		D3	3	1/2	1		
C4	D1	D2	D3		C5	D1	D2	D3		C6	D2	D2	D3		
D1	1	1/3	1/7		D1	1	1/5	1/7		D1	1	1	1		
D2	3	1	3		D2	5	1	2		D2	1	1	1		
D3	7	1/3	1		D3	7	1/2	1		D3	1	1	1		

Table 3. Average random consistency index R.I. (1000 times computation result of reciprocal judgment matrix)

Orders of matrix	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I.	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54	1.56	1.58	1.59

Table 4. Single layer ordering and test result

A	Single ordering weight		B1	Single ordering weight		B2	Single ordering weight		B3	Single ordering weight
B1	0.6522		C1	0.2500		C3	0.8333		C5	0.8333
B2	0.1304		C2	0.7500		C4	0.1667		C6	0.1667
B3	0.2174		CR	0.0000		CR	0.0000		CR	0.0000
CR	0.0000									
C1	Single ordering weight		C2	Single ordering weight		C3	Single ordering weight			Single ordering weight
D1	0.1667		D1	0.1111		D1	0.1667		D1	0.1667
D2	0.3333		D2	0.3333		D2	0.3333		D2	0.3333
D3	0.5000		D3	0.5556		D3	0.5000		D3	0.5000
CR	0.0000		CR	0.0000		CR	0.0000		CR	0.0000
C4	Single ordering weight		C5	Single ordering weight		C6	Single ordering weight			Single ordering weight
D1	0.0909		D1	0.0769		D1	0.3333		D1	0.3333
D2	0.2727		D2	0.3846		D2	0.3333		D2	0.3333
D3	0.6363		D3	0.5385		D3	0.3333		D3	0.3333
CR	0.0000		CR	0.0000		CR	0.0000		CR	0.0000

Table 5. Total ordering of layer C (CR=0.0000)

C1	C2	C3	C4	C5	C6
0.1631	0.4892	0.1087	0.0217	0.1812	0.0362

Table 6. Total ordering of layer D (CR=0.0000)

D1	D2	D3
0.1177	0.3413	0.5313

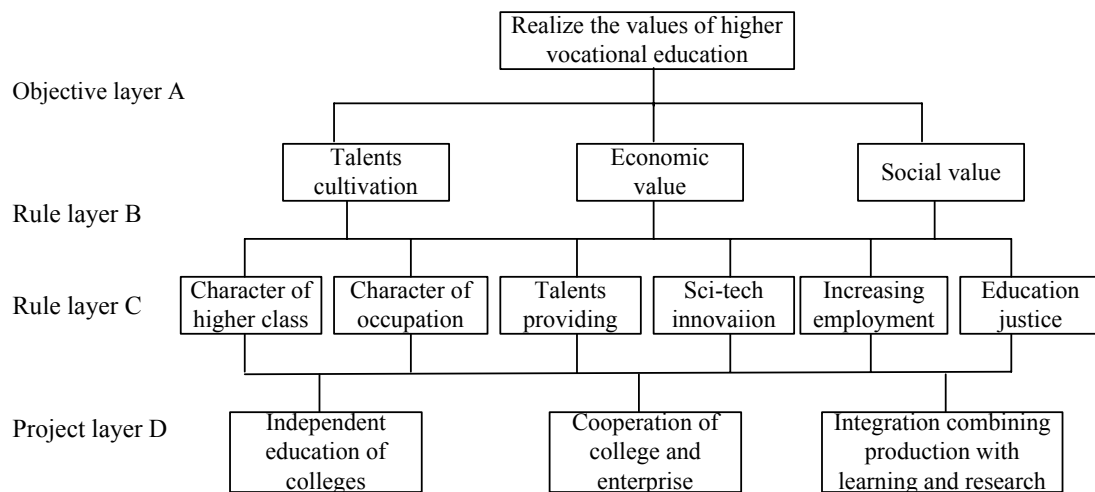


Figure 1. Sketch Map of the Hierarchical Structure