Application of Analytical Hierarchy Process on Evaluation of Teaching Quality in Farmer Distance Education Platform

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Abstract

Using website ranking tools, such as "Chinese Website Ranking", "Alexa Ranking", to evaluate the teaching quality of farmer distance education is one-sided, incompleted. To resolve this problem, this paper do research on application of Analytic Hierarchy Process (AHP) in this area. Results show that AHP is a good method on the evaluation of teaching quality in farmer distance education platform, the application of AHP can help us find out all kinds of factors easily which affect the platform's teaching quality, on the other hand it also can offer us some decision-making references to improve the platform's teaching quality.

Keywords: Analytical hierarchy process, Distance education platform, Evaluation

1. Introduction

With distance education technologies widely used in the field of farmer distance education, on-line teaching platform mushroomed in large numbers, which has developed into a new method to educate farmers, and then some researchers start to pay more attention to it. It is conducive to improve on-line teaching platform's service ability and teaching quality to ensure the long-term benefit of farmers. However it is found that few results has been done on the theoretical research, after plenty research on papers, reports and network information. Currently some website ranking tools, such as "Chinese website ranking", "Alexa ranking", are mainly used in this field. However these website ranking tools only analyze website traffic, so they are lack of comprehensiveness and objectivity due to lack of exact indicators. In addition, website ranking tools mainly by virtue of search tools bar to collect website traffic, so search tools bar installed or not has a great impact on the website's ranking. For example, if the browser installed the "Alexa Tools Bar", some information, such as the number of new users will be grabbed exactly by browser, then linked feedback to the Alexa database, and thus contribute to website ranking. In other words, if the "Alexa Tools Bar" was not be installed，there were maybe not any information to be grabbed by browser. Therefore, the use of the website ranking tools is also loss of impartiality of evaluation. In view of this, in order to solve this problem, it's necessary to study application of the AHP due to full accounting of the various factors that affect teaching quality of the farmer distance education platform.

2. AHP methodology

AHP is proposed in the early 1970s by Professor T. L. Saaty. It is broken down into goals, guidelines, programs, and oth-

er elements associated with the decision-making level, based on the qualitative and quantitative analysis of the decision-making method [1,2,3]. This method provides a concise and practical decision-making method to analyze complex problems, so it is used throughout the world in a wide variety of decision situations, such as government, business, industry, healthcare, and education.

The evaluation of teaching quality in the farmer distance education platform is a comprehensive, complex problem. If this problem is decomposed into a hierarchy structure by using the AHP according to the relationships between each element, the teaching quality can be evaluated. The hierarchy structure can be established such below. The teaching quality as a single element is located at the top-level. All kinds of elements affecting the teaching quality as evaluation indicators can be put in the lower levels. Farmer distance education platforms as alternative strategies should be listed on the lowest level.

3. Application of AHP

Application of AHP usually has four steps.

The first step is to establish a hierarchical structure. Fig.1 show a model of hierarchy structure for the evaluation of teaching quality in the farmer distance education platform. This model is established according to reference to network teaching characteristics and evaluation indicators being used in the field of farmer distance education. The model includes four levels and 29 elements.

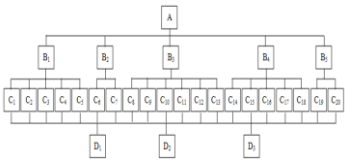

Fig. 1: Hierarchical structure model

In Fig.1, the first level is the target of evaluation, and the element A is the teaching quality. The second level as the basic principles and the basis of the evaluation is the criteria layer, including network environment B_1, organization and management B_2, teaching resources B_3, learning support B_4, and learning effects B_5. The third level is the sub-criteria layer or called indicators layers, including good program performance C_1, safe network C_2, fast information transmission C_3, operate simply C_4, color coordination C_5, positive organizational learning C_6, perfect teaching management system C_7, colorful teaching resources C_8, diverse teaching resource types C_9, fast speed of the resource update C_{10}, reasonable resource structure C_{11}, publish class schedule on time C_{12}, high resource quality C_{13}, Various teaching forms C_{14}, provide personalized learning support C_{15}, Provide operating guide C_{16}, perfect resource retrieval and navigation bar C_{17}, provide consultation service C_{18}, high website traffic C_{19}, and give the effect of feedback actively C_{20}. The fourth level , as the strategy layer mainly get the right order of teaching quality, including three farmer distance education platform D_1-D_3 which are just example in this paper.

The second step is to build pair-wise comparison judgment matrix. The judgment matrix indicates the relative importance of all the elements at the same layer to an element at the previous layer. The scale of the relative importance of a criterion is established by Saaty, and this proportional scale uses an integer of 1-9 or their reciprocal. The measurement result is expressed as a positive reciprocal matrix [4,5], shown in Tab.1-7.

The third step is to calculate the weight of single-level ranking. Each element at every level is evaluated about the elements at the previous level to acquire relative weights. Eigenvectors with corresponding to the largest eigenvalue (λ_{max}) as the weight vector (W) has been rec-

ommended by Saaty. The weight of each element in the Fig.1 is calculated by using the analysis software of AHP "yaahp", and the results are shown in Tab.1-7.

Because of the complexity of objective things and people's preference, it is need to judge the satisfaction of the pair-wise comparison judgment matrix. The judgment for the satisfaction of $\lambda_{\max}$ is made by determining the consistency ratio CR. When $CR \prec 0.1$, $\lambda_{\max}$ is satisfied, otherwise inconsistent judgments must be readjusted in order to improve the consistency. In Tab.1-7, each CR is less than 0.1.

Tab.1: (A-B) Comparison judgment matrix

A-B	B1	B2	B3	B4	B5	weight
B1	1	3	2	4	1/3	0.2557
B2	1/3	1	1/2	1	1/3	0.0946
B3	1/2	2	1	2	1/2	0.1687
B4	1/4	1	1/2	1	1/4	0.0843
B5	3	3	2	4	1	0.3967
$\lambda_{\max} = 5.1617$ $CR = 0.0361$						

Tab. 2: (B1-C) Comparison judgment matrix

B1-C	C1	C2	C3	C4	C5	weight
C1	1	1/3	5	7	1	0.2290
C2	3	1	5	7	3	0.4427
C3	1/5	1/5	1	2	1/5	0.0613
C4	1/7	1/7	1/2	1	1/7	0.0380
C5	1	1/3	5	7	1	0.2290
$\lambda_{\max} = 5.2114$ $CR = 0.0472$						

Tab. 3: (B2-C) Comparison judgment matrix

B2-C	C6	C7	weight
C6	1	3	0.7500
C7	1/3	1	0.2500
$\lambda_{\max} = 2.0000$ $CR = 0.0000$			

Tab. 4: (B3-C) Comparison judgment matrix

B3-C	C8	C9	C10	C11	C12	C13	weight
C8	1	3	5	7	1	1/3	0.1998
C9	1/3	1	2	2	1/5	1/9	0.0614
C10	1/5	1/2	1	1	1/3	1/9	0.0434
C11	1/7	1/2	1	1	1/7	1/7	0.0372
C12	1	5	3	7	1	1/3	0.1998
C13	3	9	9	7	3	1	0.4583
$\lambda_{\max} = 6.2073$ $CR = 0.0329$							

Tab. 5: (B4-C) Comparison judgment matrix

B4-C	C14	C15	C16	C17	C18	weight
C14	1	1/3	1/5	2	1/7	0.0757
C15	3	1	2	5	1	0.3301
C16	5	1/2	1	2	1	0.2307
C17	1/2	1/5	1/2	1	1/2	0.0800
C18	7	1	1	2	1	0.2835
$\lambda_{\max} = 5.4140$ $CR = 0.0924$						

Tab. 6: (B5-C) Comparison judgment matrix

B5-C	C19	C20	weight
C19	1	1/2	0.3333
C20	2	1	0.6667
$\lambda_{\max} = 2.0000$ $CR = 0.0000$			

Tab. 7: (C-D) Comparison judgment matrix

C_1-D	D_1	D_2	D_3	weight
D_1	1	5	3	0.6483
D_2	1/5	1	1/2	0.1220
D_3	1/3	2	1	0.2297
$\lambda_{\max} = 3.0037$ $CR = 0.0036$				

C_2-D	D_1	D_2	D_3	weight
D_1	1	2	1	0.4126
D_2	1/2	1	1	0.2599
D_3	1	1	1	0.3275
$\lambda_{\max} = 3.0536$ $CR = 0.0516$				

C_3-D	D_1	D_2	D_3	weight
D_1	1	1/2	1	0.2402
D_2	2	1	3	0.5499
D_3	1	1/3	1	0.2098
$\lambda_{\max} = 3.0183$ $CR = 0.0176$				

C_4-D	D_1	D_2	D_3	weight
D_1	1	1/2	2	0.2970
D_2	2	1	3	0.5396
D_3	1/2	1/3	1	0.1634
$\lambda_{\max} = 3.0092$ $CR = 0.0088$				

C_5-D	D_1	D_2	D_3	weight
D_1	1	2	1	0.3874
D_2	1/2	1	1/3	0.1692
D_3	1	3	1	0.4434
$\lambda_{\max} = 3.0183$ $CR = 0.0176$				

C_6-D	D_1	D_2	D_3	weight
D_1	1	1/9	1/7	0.0583
D_2	9	1	1/2	0.3828
D_3	7	2	1	0.5589
$\lambda_{\max} = 3.0999$ $CR = 0.0961$				

C_7-D	D_1	D_2	D_3	weight
D_1	1	2	1	0.3874
D_2	1/2	1	1/3	0.1692
D_3	1	3	1	0.4434
$\lambda_{\max} = 3.0183$ $CR = 0.0716$				

C_8-D	D_1	D_2	D_3	weight
D_1	1	7	5	0.7306
D_2	1/7	1	1/3	0.0810
D_3	1/5	3	1	0.1884
$\lambda_{\max} = 3.0649$ $CR = 0.0624$				

C_9-D	D_1	D_2	D_3	weight
D_1	1	1/5	1/3	0.1140
D_2	5	1	1	0.4806
D_3	3	1	1	0.4054
$\lambda_{\max} = 3.0291$ $CR = 0.0279$				

C_{10}-D	D_1	D_2	D_3	weight
D_1	1	2	1	0.3874
D_2	1/2	1	1/3	0.1692
D_3	3	1	1	0.4434
$\lambda_{\max} = 3.0183$ $CR = 0.0176$				

C_{11}-D	D_1	D_2	D_3	weight
D_1	1	1/2	1	0.2402
D_2	2	1	3	0.5499
D_3	1	1/3	1	0.2098
$\lambda_{\max} = 3.0183$ $CR = 0.0176$				

C_{12}-D	D_1	D_2	D_3	weight
D_1	1	7	1/2	0.3458
D_2	1/7	1	1/9	0.0572
D_3	2	9	1	0.5969
$\lambda_{\max} = 3.0217$ $CR = 0.0209$				

C_{13}-D	D_1	D_2	D_3	weight
D_1	1	2	3	0.5396
D_2	1/2	1	2	0.2970
D_3	1/3	1/2	1	0.1634
$\lambda_{\max} = 3.0092$ $CR = 0.0088$				

C_{14}-D	D_1	D_2	D_3	weight
D_1	1	1/4	1/2	0.1265
D_2	4	1	5	0.6870
D_3	2	1/5	1	0.1865
$\lambda_{\max} = 3.0940$ $CR = 0.0904$				

C_{15}-D	D_1	D_2	D_3	weight
D_1	1	5	3	0.6483
D_2	1/5	1	1/2	0.1220
D_3	1/3	2	1	0.2297
$\lambda_{\max} = 3.0037$ $CR = 0.0036$				

C_{16}-D	D_1	D_2	D_3	weight
D_1	1	1/4	3	0.2109
D_2	4	1	7	0.7049
D_3	1/3	1/7	1	0.0841
$\lambda_{\max} = 3.0324$ $CR = 0.0311$				

C_{17}-D	D_1	D_2	D_3	weight
D_1	1	1/4	1/3	0.1260
D_2	4	1	1	0.4579
$D3$	3	1	1	0.4161
$\lambda_{\max} = 3.0092$ $CR = 0.0088$				

C_{18}-D	D_1	D_2	D_3	weight
D_1	1	1/3	3	0.2583
D_2	3	1	5	0.6370
$D3$	1/3	1/5	1	0.1047
$\lambda_{\max} = 3.0385$ $CR = 0.0370$				

C_{19}-D	D_1	D_2	D_3	weight
D_1	1	7	3	0.6694
D_2	1/7	1	1/3	0.0879
D_3	1/3	3	1	0.2426
$\lambda_{\max} = 3.0070$ $CR = 0.0068$				

C_{20}-D	D_1	D_2	D_3	weight
D_1	1	1/4	2	0.1870
D_2	4	1	7	0.7153
D_3	1/2	1/7	1	0.0977
$\lambda_{\max} = 3.0020$ $CR = 0.0019$				

The fourth step is to calculate the weight of hierarchy general ranking. The weight of the entire hierarchy is acquired using the weights of the elements at each level. This process is carried out in order from the highest level to the lowest level. In this step, the judgment for the satisfaction of λ_{max} is also necessary by calculating the consistency ratio CR just like in third step.

According to the above calculation result of single-level ranking, the combined weight can be acquired. The C layer to the A layer (A-C) combined weight is: (0.0585,0.1132,0.0157,0.0097,0.0585,0.0710,0.0237,0.0337,0.0104,0.0073,0.0063,0.0337,0.0773,0.0064,0.0036,0.0195,0.0067,0.0239,0.1322.0.2645)^T, $CR = 0.0495$; the D layer to the A layer (A-D) combined weight is : (0.3788,0.2518,0.3694)^T, $CR = 0.0204$. Because any CR is less than 0.1, the combined weight is acceptable.

According to the (A-D) combined weight, the teaching quality of three farmer distance education platform can be evaluated as $D_1 > D_3 > D_2$. In addition to high website traffic C_{19}, The main elements also have the following elements: give the effect of feedback actively C_{20}, safe network C_2, and high resource quality C_{13}.

4. Conclusion

In short, application of the AHP on the evaluation of the teaching quality in farmer distance education platform is very scientific, also can help to find out the key factors that affect the teaching quality, and provide important references for the decision makers. But if there were excessive elements at each layer in the hierarchical structure model, pair-wise comparison judgment would become difficult. This is an issue that needs to be deliberated in future.

5. References

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