Research on the Evaluation System of E-commerce Specialty Based on TOPSIS and Analytic Hierarchy Process

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Abstract
The large data technology of information society on people's lives and social development had a tremendous impact which is higher education combined with large data, and the large data technology timely reform is the future development trend. This paper is based on the actual requirements of e-commerce professional disciplines evaluation. From the two aspects of job performance and teacher's ability, we should have quality to build a more comprehensive three-level discipline construction evaluation index system. AHP method helps to determine the weight of indicators at all levels, and give the evaluation of different factors. Quantitative analysis of indicators is based on TOPSIS method to achieve a comprehensive ranking of the evaluation results. Finally, an example is given to illustrate. To a certain extent, the use of this method can reduce the evaluation process in the subjective factors, and it will be scientific and operational.

Key words: Big Data, Analytic Hierarchy, TOPSIS

1. INTRODUCTION

Big data was born in people on the ability to collect data, transmission capacity, processing and analysis capabilities on the basis of the development which has set off a wave of changes, and the development potential is huge. McKinsey, a well-known management consulting firm, believes that big data is a large amount of complex data sets which exceed the size of conventional database software tools to acquire, store, manage and analyze. Amazon believes that big data is any amount of data that exceeds a computer's processing power. From a macro point of view, big data is the integration of the physical world, information space and human society ternary world ties. In the field of education, the process of teaching and learning also contains valuable large amounts of data, how to effectively dig, analyze and use these massive data to promote teaching, is the hot research content of today's education sector.

The next decade will be a "big data" to lead the wisdom of science and technology era. Digital information is updated annually by geometric progression, and by 2020, the amount of data will exceed people's imagination to 40ZB. The development of e-commerce professional disciplines must adhere to the quantitative and quality of the coordinated development of the principle. Especially in the rapid development of e-commerce at this stage, attention to e-commerce professional discipline construction and personnel training quality is particularly important. For example, the UK e-commerce professional discipline attaches great importance to the external quality of education, since the end of the twentieth century efforts to build a new type of higher education quality assurance system, including a unified evaluation of institutions and evaluation criteria. The UK's assessment bodies include the Higher Education Quality Assurance Agency, whose main task is used to assess the quality and standards of higher education in the UK, and then the UK has begun to implement research assessments, teaching quality assessments and academic quality audits that not only promote the UK's high institutions and the level of scientific research, but also greatly promoted the British institutions of higher learning e-commerce professional evaluation of the improvement level. Similarly, Japan has established a university council; the United States established a post-secondary education appraisal committee, the Office of Qualification and Institutional Assessment, and the National Higher Education Accreditation Board. Sweden established the Higher Education Quality Department Wait. Countries also develop a relatively reasonable evaluation index system which is based on the development of their socio-economic, political and scientific research, educational goals and tasks of the schools, and clearly define the functions of the assessment bodies.

The quality of e-commerce professional discipline construction and personnel training is the lifeline of e-commerce professional evaluation, and the implementation of e-commerce professional discipline evaluation, the e-commerce professional discipline evaluation and personnel training quality has a certain "identification, guiding role, diagnostic role and supervisory role", the evaluation criteria for the cultivation of graduate students should play a function of assessment, which is reflecting the purpose of the assessment. At present, there are AHP method, system comprehensive evaluation method and TOPSIS method in the academic research on talent evaluation. The research object is focused on the enterprise Managers, employees, and college administrators.
Chen Shaoxiong proposed the use of analytic hierarchy process and fuzzy mathematics method to evaluate the training mode of postgraduates in China, and Wang Xiaoman put forward the first-level evaluation index and secondary index for the cultivation of graduate students. Based on the above work, this paper puts forward the comprehensive utilization of AHP and TOPSIS to evaluate the conditions of e-commerce discipline construction and personnel training, and determine the relative weight of evaluation index and evaluation factors, and to quantify the various qualitative indicators. The method of approximating the ideal solution is used to sort the merits of the evaluation.

2. ANALYTIC HIERARCHY PROCESS

2.1. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a practical multi-program or multi-objective decision-making method. Its main feature is that it is reasonable to combine qualitative and quantitative decision-making, in accordance with the thinking, psychological law to the decision-making process level. Since 1982, this method has been introduced to our country, with its qualitative and quantitative combination of various decision-making factors to deal with the characteristics of its system flexibility and simplicity of the advantages of rapid socio-economic areas in China, such as energy system analysis.

The basic idea of the analytic hierarchy process is used to decompose the integrated system thought.

First, the problem to be analyzed will be hierarchized, according to the nature of the problem and to achieve the overall goal, the problem is divided into different components, according to the relationship between the factors and affiliation, the factors gathered at different levels. Layer analysis of structural models, and ultimately attributed to the lowest level and relative to the highest level.

When using the AHP method to make decisions, you need to go through the following four steps:
1. The establishment of the system hierarchical structure.
2. Construct two comparison judgment matrix (positive reciprocal matrix).
3. For a certain standard, we can calculate the weight of the alternative elements.
4. Calculate the current level of elements on the overall goal of the sorting weight.
5. To conduct a consistency test.

This method is used to determine the relative importance of each indicator. The corresponding importance judgment matrix is obtained by comparison of the two pairs. The criteria for judging can be seen from the following table 1.

<table>
<thead>
<tr>
<th>w</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>2,4,6,8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rij</td>
<td>Equally important</td>
<td>Slightly important</td>
<td>Obviously important</td>
<td>Strongly important</td>
<td>Absolutely important</td>
<td>The degree of importance between the grades</td>
</tr>
</tbody>
</table>

**Table 1** Compares the importance judgment matrices

W denotes the respective rank, R_{ij} is the importance of the index i compared with the index j, and the importance of the index j and the index i is R_{ij} = 1 / R_{ji}.

We calculate the largest eigenvalue \( \lambda_{\text{max}} \) of the matrix, and the normalized eigenvector corresponding to \( \lambda_{\text{max}} \) is the weight of each index in the target.

And then we can test the consistency of the judgment matrix by \( CI = (\lambda_{\text{max}} - n) / (n - 1) \).

\( RI \) is the average then consistency index, after a large number of try comparison and theoretical analysis, experts for \( n = 1, 2, ..., 8 \), given the value of \( RI \) which is shown in Table 2.

<table>
<thead>
<tr>
<th>N</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0</td>
<td>0.58</td>
<td>0.9</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2** Index of average casual consistency

\( CR \) is called the consistency ratio, \( CR = \frac{CI}{RI} \) when \( CR \leq 0.1 \), it can be considered that the judgment matrix has a more satisfactory consistency, otherwise it should be re-adjusted.

2.2. Model hierarchy

By looking for data and analysis, we layered the model as follows.
The total score

Figure 1. E-commerce professional AHP model hierarchy

Target layer: total score;
Criterion layer 1: pre-investment, teaching, research;
Criterion Layer 2: Discipline Construction, Teaching Award, Team Building, Personnel Training, Scientific Research Achievement Award, Scientific Research Achievements
Standard Level 3: Level 1 Discipline National Key Discipline, Level 2 National Key Discipline, Doctoral Degree Authorization, Master Degree Authorization, National, Provincial, Teacher, Doctor, Doctor, Master, Postdoctoral, National, Other, SCI / SSCI, EI, ISTP, CSSCI, government reports, patents, monographs.
Criterion Layer 4: Professor, Associate Professor, b1, b2, b3, b4, b5, b6, b7, b8.

2.3. The indicators are converted to scores
The scores of this model are given percentile. Since the model's indicators are mostly quantitative and have no upper limit, we use the following method to calculate the scores for each metric.

We can find the maximum value \( D_{\text{max}} \) in all data and set its score to 100. For other data, we can apply the formula.

\[
S_i = \frac{D_i}{D_{\text{max}}} \times 100
\]  

(1)

This translates the data into scores.

3. TOPSIS METHOD TO CALCULATE THE RELATIVE DEGREE OF EVALUATION RESULTS

Topsis method is a common method for multi-objective decision analysis of finite scheme in system engineering. Based on the normalized original data matrix, the optimal scheme and the worst case scheme (expressed by the optimal vector and the worst vector respectively) in the finite scheme are found out, and then the evaluation objects are compared with the optimal scheme. The distance between the evaluation object and the optimal scheme is obtained as the basis for evaluating the merits and demerits.

3.1. The basic principles
TOPSIS method is the abbreviation of Technique for Order Preference to Similar Solution to Ideal Solution, which is a technique of approximation to ideal solution. It is a multi-objective decision method. The basic idea of the method is used to define the ideal solution and the negative solution of the decision problem, and then find a solution in the feasible scheme to make it the closest distance from the ideal solution and the farthest away from the ideal solution.

The ideal solution is usually the best idea, and the corresponding attributes are at least the best of the various schemes. The negative ideal solution is assumed to be the worst case, and the corresponding attributes are at least not better than the ones in each scheme. The decision-making rule of the scheme is the comparison...
of the practical feasible solution and the ideal solution. If a feasible solution is closest to the ideal solution and the farthest away from the negative ideal solution, then the solution is the satisfactory solution of the scheme set.

3.2. TOPSIS method to calculate the relative close of the evaluation results

The TOPSIS method is a method of evaluating the level of the evaluation object by the degree of relative proximity \( C_i^* \). The higher the value \( C_i^* \) is, the higher the level of the object being evaluated. Specific steps are as follows.

1. **Construction decision matrix**
   According to the comprehensive evaluation of the indicators obtained from 4.2 and 4.3, the decision matrix is obtained as \( A \).
   \[
   A = (a_{ij})_{m \times n}
   \]
   In the formula, \( a_{ij} \) is the evaluation of the indicators \( i \) for the evaluation of the value \( j \), \( m \) is on behalf of the number of respondents, \( n \) is on behalf of the evaluation index.

2. **Do not dimension the elements in the matrix \( A \)**
   The quantitative indicators in the matrix \( A \) have different dimensions, the need for dimensionless should be processed of indicators.
   \[
   r_{ij} = \frac{a_{ij}}{\left[ \sum_{j=1}^{m} a_{ij}^2 \right]^{1/2}}
   \]
   We can calculate Weighted Normalized Matrices.
   \[
   V = (v_{ij})_{m \times n} = (\omega_j r_{ij})_{m \times n}
   \]
   In the formula, \( \omega_j \) is the weight of the index \( j \), which is the element \( r_{ij} \) after dimensionless.
   Determine the ideal and negative ideal. 
   \( V_j^* \) is the ideal point, \( V_j^0 \) is used for the negative ideal point.
   \[
   \begin{align*}
   V_j^* &= \left\{ (\max v_{ij}, j \in J), (\min v_{ij}, j \in J^') \right\}, j = 1, 2, \ldots, n, \\
   V_j^0 &= \left\{ (\min v_{ij}, j \in J), (\max v_{ij}, j \in J^') \right\}, j = 1, 2, \ldots, n
   \end{align*}
   \]
   It is the index set \( J \) that is bigger and better than the target, and it is the index set \( J^' \) that is smaller as far as the target is concerned.

3.3. Calculate the distance between the positive and negative ideal solutions of the evaluated results

The distance from each evaluation result to the positive solution is as follows.
   \[
   d_i^* = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_{ij}^*)^2}, i = 1, 2, \ldots, m
   \]
   The distance from each evaluation result to the negative ideal solution is \( d_i^0 \).
   \[
   d_i^0 = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_{ij}^0)^2}, i = 1, 2, \ldots, m
   \]
   We can calculate the relative proximity.
   \[
   C_i^* = \frac{d_i^0}{(d_i^0 + d_i^*)}, i = 1, 2, \ldots, m
   \]
   In descending order of \( C_i^* \), it is easy to determine the merits of each appraiser.

4. CASE DESCRIPTION AND EXAMPLE ANALYSIS

A province then evaluates the construction of e-commerce disciplines in five colleges and universities, which mainly includes the comprehensive evaluation of teachers’ job performance, and sorting them according
to the evaluation results. In the evaluation, seven members of the committee, 15 key teachers, 30 full-time teachers and students' professional achievements were selected as the evaluation contents.

4.1. Determine the weight of each evaluation index relative to the overall goal

We can see the data as shown in Table 1, this study uses AHP to obtain the weight of all the evaluation indicators relative to the total target

\[ W = (0.1077, 0.0722, 0.0722, 0.0862, 0.0259, 0.0210, 0.0206, 0.0218, 0.0178, 0.0182, 0.0226, 0.0258, 0.0210, 0.0206, 0.0218, 0.0178, 0.0182, 0.0226) \]

4.2. Calculate the membership degree of the qualitative index fuzzy evaluation comment set

(Excellent) = 0.91   (good) = 0.77   (general) = 0.66   (poor) = 0.44

4.3. Calculate the comprehensive rating of each appraiser on an indicator

The formula 2 can be obtained for each evaluation method of the candidates in the first qualitative indicators on the assessment value. For example, the evaluation of the "college 1" in the qualitative index "moral cultivation" of the assessment value is

\[ d_1 = \frac{\sum_{j=1}^{4} n_j \times \mu_i(M_j)}{7} = \frac{6 \times 0.91 + 1 \times 0.77}{7} = 0.89 \]

In the same way, other evaluation methods can be used to assess the value of "college 1" in the qualitative index "moral accomplishment",

\[ d_2 = 0.86, d_3 = 0.8747, d_4 = 0.91 \]

The formula 3 can be obtained in each of the qualitative indicators of each comprehensive evaluation of the value, for example, college 1 in the moral cultivation of the comprehensive assessment of the value.

\[ a_1 = \sum_{i=1}^{4} k_i d_i = 0.8799 \]

Similarly, we can get the other four colleges in the moral character of the comprehensive assessment of the value.

\[ a_2 = 0.7952, a_3 = 0.7902, a_4 = 0.7307, a_5 = 0.8283 \]

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Qualitative index &quot;moral accomplishment&quot; fuzzy evaluation raw data table</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Gd</td>
</tr>
<tr>
<td>University 1</td>
<td>6</td>
</tr>
<tr>
<td>University 2</td>
<td>3</td>
</tr>
<tr>
<td>University 3</td>
<td>2</td>
</tr>
<tr>
<td>University 4</td>
<td>1</td>
</tr>
<tr>
<td>University 5</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Comprehensive evaluation form of professional construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>University 1</td>
<td>0.8867</td>
</tr>
<tr>
<td>University 2</td>
<td>0.8021</td>
</tr>
<tr>
<td>University 3</td>
<td>0.7984</td>
</tr>
<tr>
<td>University 4</td>
<td>0.7030</td>
</tr>
<tr>
<td>University 5</td>
<td>0.8592</td>
</tr>
</tbody>
</table>
The positive and negative ideal solutions are obtained by formulas (5) and (6).

\[ V_j^+ = (0.0608, 0.0359, 0.0354, 0.0408, 0.0554, 0.0055, 0.0000, 0.0240, 0.0151, 0.0000, 0.0163, 0.0193, 0.0188, 0.0106, 0.0113, 0.0121, 0.0014, 0.0088, 0.0090) \]

\[ V_j^- = (0.0304, 0.0279, 0.0277, 0.0318, 0.0092, 0.0164, 0.0634, 0.0185, 0.0094, 0.0129, 0.0160, 0.0168, 0.0094, 0.0079, 0.0109, 0.0085, 0.0082, 0.0225, 0.0207, 0.0066, 0.0038, 0.0076, 0.0080) \]

We can calculate the distance between the evaluation results of the evaluated participants and the positive ideal solution and the negative ideal solution. Which is calculated by formulas (7) and (8).

\[ d_j^+ = 0.0009; d_j^- = 0.0087; d_4^+ = 0.0482; d_4^- = 0.0413; d_3^+ = 0.0322; d_3^- = 0.0716; \]

\[ d_2^+ = 0.0885; d_2^- = 0.0041; d_2^- = 0.0136; d_1^- = 0.0805; \]

### 4.4. Computation relative proximity

We can calculate by formula (9).

University 1 (0.9904), University, 5 (0.8555), University, 3 (0.6897), University, 2 (0.4612), University, 4 (0.4046)

### 5. CONCLUSION

The reform and development of e-commerce professional education is an important subject related to our country's national competitiveness. It is urgent and realistic for the evaluation of the e-commerce students' development in China at present. Based on the realistic needs of e-commerce teachers' evaluation, this paper designs the indexes of comprehensive evaluation of e-commerce professional teachers on the basis of analyzing the shortcomings of teachers' evaluation in the past. In order to highlight the objectivity of the evaluation index, this study focuses on the selection of indicators and the daily work of college teachers, and selects 10 indicators of E-commerce professional teachers' performance. At the same time, the selection of 14 indicators reflects the comprehensiveness of the evaluation, from the four aspects of it to assess the quality of e-commerce professional teachers. On this basis, the author analyzes the relative weight of each index by using AHPIS method to synthesize the results of each teacher's evaluation. Finally, a case is described. This research is an improvement of the existing e-commerce professional teacher evaluation method, which has certain practical significance. We are hoping to explore through the relevant ideas for China's e-commerce professional disciplines to reform and development of new methods and useful reference.

### REFERENCES


