A Comprehensive Teaching Evaluation Method of Computer Network Course based on TOPSIS Algorithm

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Abstract
Computer network course is a rapidly developing interdisciplinary applied subject. The teaching of this course is very difficult, which can not easily obtain the satisfactory teaching effect. With the rapid development of Internet technology and the continuous promotion of quality education reform thought, it provides an excellent environment for the development of computer network course teaching. The main content to evaluate the teaching effect of computer network course is the teaching assessment and evaluation. At present, there are some deficiencies in the teaching evaluation of computer network course, which can not truly reflect the students’ learning situation. In this regard, the application of comprehensive evaluation method in the computer network course teaching can form a scientific teaching evaluation system, and promote the development of computer network course teaching. This paper sets up the teaching evaluation index of computer network course, constructs a comprehensive evaluation model of computer network course teaching, and puts forward a comprehensive evaluation method of computer network course teaching based on TOPSIS algorithm, and through the implementation of teaching evaluation, this paper proves that this method improves the quality of teaching and has a certain teaching effect.

Keywords: Computer, Evaluation Model, Network Course, Comprehensive Evaluation Method, TOPSIS Algorithm

1. INTRODUCTION

With the rapid development of education, innovative teaching methods and teaching ideas of constantly updated (Sachdeva, Kumar and Singh, 2016). When the Ministry of Education promulgated and implemented the evaluation mechanism of teaching level in Colleges and universities, the comprehensive evaluation of the teaching work has become increasingly scientific and reasonable (Bhuyan, Bhattacharyya and Kalita, 2015). At present, the comprehensive evaluation of classroom teaching, especially the teaching evaluation of computer network courses has become the focus of attention from all walks of life, scientific evaluation system is also the goal of people's in-depth research (David and Thomas, 2015). For the school in terms of the objective evaluation of the teaching level of teachers is the main content of higher education, which can judge teachers teaching more just, can not only encourage teachers to innovate teaching methods, but also highly affirmed the teachers' teaching achievements (Rahmani, Sahli and Kamoun, 2012). Therefore, the comprehensive evaluation of classroom teaching is not only the needs of school teaching evaluation, but also the main measures to improve the teaching level of teachers, which directly promotes the healthy development of computer network course teaching.

However, there is a lack of profound research on classroom teaching evaluation, especially the teaching evaluation of computer network course (Alenezi and Reed, 2014). The evaluation methods of teaching computer network course lack of diversity, not involving extensive evaluation group (Saied, Overill and Radzik, 2016). Many colleges and universities are generally simple evaluation of computer network course teaching, the teachers of this school is usually the evaluation group, few students are able to participate, even if there is a part of college students can participate in the computer network curriculum teaching evaluation, can not completely show the essence of object teaching evaluation of computer network course, only some of the data processing is simple, which cannot obtain scientific and objective conclusion (Tariq, 2011). Evaluation of computer network teaching is lack of the standard. In most of the computer network curriculum teaching evaluation project, evaluation and other disciplines cannot effectively distinguish standard, also can not truly reflect the characteristics of computer network teaching evaluation, the evaluation to promote the healthy development of students. The lack of classroom teaching evaluation model of computer network. Take the computer network curriculum teaching evaluation in many schools is rarely use the expert grading method of teaching evaluation.
plays the actual value of the multivariate statistical analysis method, attribute evaluation method, the specific students is evaluated by questionnaire score obtained in the teaching of computer network.

The main basis of classroom teaching evaluation is the modern classroom teaching, using the feasibility means, combined with the various elements of classroom teaching and development and change, the implementation of the process of value judgment (Beitollahi and Deconinck, 2012). Objective to evaluate the teaching of computer network, you can better help the teacher to adjust the teaching evaluation design, improve teaching behavior and motivate its carry out creative teaching activities; at the same time also can optimize classroom teaching, improve the teaching level of teachers, promote the continuous growth; and favorable to the education sector to make scientific decision. The computer network curriculum teaching evaluation has a positive impact on teachers and students, the scientific evaluation of the computer network curriculum teaching, innovative teaching methods, improve teaching methods, improve teaching strategies, while maximizing the efficiency of learning computer network curriculum students better internalized knowledge, improve their learning level, this evaluation method emphasizes the teaching evaluation of students in the course of computer network function (Vissers, 2014). Through the comprehensive evaluation of computer network course teaching, fully guarantee the teaching quality of computer network course, thus promoting the development of computer network course teaching. In the teaching of computer network course, the application of comprehensive evaluation method can be more objective and reasonable evaluation of teaching, greatly improving the effectiveness of computer network course teaching.

2. APPLICATION OF COMPREHENSIVE EVALUATION METHOD IN COMPUTER NETWORK COURSE TEACHING

In order to successfully solve the defects of teaching evaluation in the course of computer network, enhance the evaluation effect, highlight the rationality, evaluation methods to evaluate the content of the comprehensive evaluation results, the accuracy and effectiveness of the evaluation mechanism, and the integration of science of traditional evaluation methods, using the most advanced management methods, using AHP method combining qualitative analysis and assessment quantitative assessment, so as to construct a reasonable evaluation index, clear assessment standard, further in-depth evaluation. The analytic hierarchy process involves the calculation of large scale and complex to use, caused a certain influence, therefore, fuzzy comprehensive evaluation method analysis method has simple operation based on the characteristics of easy application, its application in the teaching of computer network:

2.1. The Teaching Evaluation Index System of Computer Network Course

The evaluation index of computer network curriculum teaching should have certain differences in different regions and schools, indicators, standards and weights of the computer network curriculum teaching evaluation of these different schools and regions will appear significantly different. Indeed there are many aspects of all regions and school uniform requirements. The design evaluation index requires not only the comprehensive reflection of the teaching of computer network courses, but also to keep as simple as possible, conducive to operation. The development of the computer network course contact situation, the expert consultation on the choice of evaluation index of computer network teaching is more common, including 6 first level indicators, 20 level two indexes.

| Table 1. Teaching evaluation index of computer network course |
|---------------------------------|----------------|
| Teaching evaluation index of computer network course | Courseware B1 |
| Teaching environment A1 | Media application B2 |
| | Teaching atmosphere B3 |
| Teacher A2 | Computer network operation skills B4 |
| | Computing network application capability B5 |
| | Network consciousness B6 |
| | Modern education direction B7 |
| Teaching preparation A3 | Problem design B8 |
| | Teaching strategy design B9 |
| | Teaching activity design B10 |
| | Capability goal design B11 |
| | Discipline goal design B12 |
| | Understanding the characteristics of students B13 |
| Student A4 | Computing network technology capability B14 |
The curriculum teaching evaluation is the whole process of setting the target as the standard value judgment, belonging to a comprehensive concept, involving the specific content of teaching, teaching level, teaching effect and so on. Contact with the actual situation of the school, choose from the teaching environment, teachers, teaching preparation, students, classroom implementation and other aspects of evaluation.

### 2.2. Fuzzy Comprehensive Evaluation Model for Computing Network Course Teaching

Through fuzzy mathematics, the whole evaluation of things or objects restricted by various factors can be called fuzzy comprehensive evaluation method. This is the main method of membership function by single factor to influence the evaluation object to a factor that influence each after taking comprehensive weighting factors of evaluation object, obtain the comprehensive evaluation about the evaluation object.

The main idea of the method of fuzzy comprehensive evaluation is: in the premise of a clear evaluation of level indicators, two indicators of the rating criteria and weights, adopt fuzzy set change principle, take the factors of evaluation object, obtain the comprehensive evaluation about the factor to influence the evaluation object to a factor that influence each after taking comprehensive weighting.

The specific steps of fuzzy evaluation are as follows:

1. The relationship matrix, adopting composite computing multi-level, the evaluation object the corresponding level clear.

2. Construct the candidate set V, this collection includes a variety of factors affect the evaluation object.

3. Construct the weight set of various factors formed on different degrees of importance of these factors for reflection, which will need a certain weight to each factor, the comprehensive weights for each set of weights.

4. Construct a single factor evaluation matrix.

5. Construct a fuzzy comprehensive evaluation.

6. Construct a disposal evaluation index, and the related methods include the maximum membership method, weighted average method and fuzzy distribution method.

First level fuzzy comprehensive evaluation is the most basic form of fuzzy comprehensive method, which can deal with relatively simple problems, and then obtain more scientific results. But in the face of very complex problems, due to the need to consider all kinds of factors, each factor has formed different levels, and also used multi-level fuzzy comprehensive evaluation method.

There are n evaluation levels, m first level evaluation indicators, each level index includes a number of two level indicators, U, V, Vi and other symbols to express, that is

- Hierarchy theory domain $U = \{u_1, u_2, ..., u_m\}$
- First level index domain $V = \{v_1, v_2, ..., v_n\}$
- Two level index domain $V_i = \{v_1, v_2, ..., v_k\}$

Because of the fuzzy relation $V$ between $U$ and $R$, the fuzzy matrix form can be expressed: $u_1, u_2, ..., u_m$

$$R = \begin{pmatrix}
V_1r_1r_1 \land r_{nm} \\
V_2r_2r_2 \land r_{nm} \\
\vdots \\
V_mr_mr_m \land r_{nm}
\end{pmatrix}
$$

(1)

where $R$ represents the i evaluation factors on $V_i$ levels of the membership, the weight of each factor is mainly dependent on the $V_i$ including membership to each and every factor of the factors in the formation of $V_i$. 

<table>
<thead>
<tr>
<th>Classroom implementation A5</th>
<th>Operation performance of computer network technology B15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching evaluation A6</td>
<td>Maintain students’ interest in learning B16</td>
</tr>
<tr>
<td></td>
<td>Students’ participation in learning B17</td>
</tr>
<tr>
<td></td>
<td>Teachers grasp the goal B18</td>
</tr>
<tr>
<td></td>
<td>Classroom evaluation method B19</td>
</tr>
<tr>
<td></td>
<td>Student learning effect B20</td>
</tr>
</tbody>
</table>
including the P hypothesis factors on the levels of the membership degree is \( q \):

\[
S_{nq}(p = 1,2,\ldots,k, q = 1,2,\ldots,n).
\]

The weight of the factor \( p \) is equal to that of the factor \( k \), then

\[
\begin{pmatrix}
(r_{11}, r_{12}, A, r_{kn}) = (w^1, w^2, \ldots, w_k)
\end{pmatrix}
\]

In this way, the fuzzy relation matrix is defined. That is, the weight of the primary evaluation factor is

\[
A = [a_1, a_2, \ldots, a_n]
\]

The results of comprehensive evaluation are as follows

\[
W = AR = (w_1, w_2, \ldots, w_n)
\]

If \( q_k = \max(q_{d1}, q_{d2}, \ldots, q_{dn}) \), the object of evaluation is class \( K \).

In the actual evaluation work, generally by experts, leaders and students as the evaluation of all staff members will have different evaluation results, the different importance, then you can get such analysis: first of all kinds of personnel evaluation comprehensive evaluation results according to the above method, the weighted average to obtain the total evaluation conclusion.

2.3. Determination of Weight Set \( A \) of Computer Network Course Teaching

The weight of each index in the model by using Delphi method of AHP positive clear, our approach is: to invite more than computer network technology education experts to score, after statistical experts, as the main weight according to the confirmed.

Step 1. Establish the judgment matrix. According to the level and relationship among the teaching evaluation indexes of computer network course, the judgment matrix is established, and the construction of judgment matrix at different levels is noticed. For example, the 6 indicators of a class index level can be used to establish 1 judgment matrixes for the evaluation index of computer network course teaching, and 6 judgment matrixes can be established at the level of B index. According to the two level index hierarchy of B1, B2, B3 and the first level index hierarchy of A1, the judgment matrix is established as follows:

<table>
<thead>
<tr>
<th>A1</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>B2</td>
<td>1/2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>B3</td>
<td>1/4</td>
<td>1/3</td>
<td>1</td>
</tr>
</tbody>
</table>

Similarly, other hierarchical judgment matrix also can be establish.

Step 2. make the opinion solicitation list and assign the elements at different levels quantitatively. Issuing questionnaires, does not need to be experts on specific weight values, but the experts according to their accumulated experience and abundant professional knowledge, the importance of factors affecting the teaching level of computer network course to carry out an objective and reasonable judgment, 22 indexes of the scale value. Indicators use 1, 2, ..., 9, and 1/2, 1/3, ..., 1/9 to indicate the importance of each other. The meanings of these numerical values are shown in table 3.

Table 3 is the assignment of the relative importance of two elements. If the comparison between one index and another index is secondary, the assignment selects the reciprocal of the data.

The relevant opinions of statistical experts, take four illegal to carry out statistical analysis and feedback analysis results to the experts, the experts also launched a new round of score; this cycle repeated, matrix scale numerical convergence judgment until the end.

<table>
<thead>
<tr>
<th>Degree of importance or degree of excellence</th>
<th>Assignment</th>
<th>Explain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

526
The two factors are of the same importance, or very superior | 1 | One of the two factors makes the same contribution
---|---|---
One factor is slightly more important or slightly superior to the other | 3 | Based on the empirical analysis, the two factors are slightly more important than a certain factor
One factor is more important and superior to the other | 5 | Based on the empirical angle analysis, the two factors focus on one factor
A factor is very important or very superior to another factor | 7 | Through practice, a certain factor plays a leading role
One factor is extremely important or superior to another | 9 | One of the two factors plays an absolute role
The intermediate state of the above two proximity levels | 2,4,6,8 | When the description is very clear, this method is used to interpolate

Step 3. defines the relative weight of each layer index and the total weight of the multi-level merging. According to the judgment matrix of each layer obtained, using square root algorithm of each layer index compared with a layer of index weight is calculated after each layer of indexes related to the relative weight by weight of each index is combined with multi.

**Table 4. First class index weight**

<table>
<thead>
<tr>
<th>First level index</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>A6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.107</td>
<td>0.246</td>
<td>0.173</td>
<td>0.102</td>
<td>0.091</td>
<td>0.281</td>
</tr>
</tbody>
</table>

**Table 5. Two level index weight**

<table>
<thead>
<tr>
<th>Index</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
<th>B5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.338</td>
<td>0.098</td>
<td>0.234</td>
<td>0.109</td>
<td>0.532</td>
</tr>
<tr>
<td>Index</td>
<td>B6</td>
<td>B7</td>
<td>B8</td>
<td>B9</td>
<td>B10</td>
</tr>
<tr>
<td>Weight</td>
<td>0.246</td>
<td>0.123</td>
<td>0.315</td>
<td>0.0100</td>
<td>0.207</td>
</tr>
<tr>
<td>Index</td>
<td>B11</td>
<td>B12</td>
<td>B13</td>
<td>B14</td>
<td>B15</td>
</tr>
<tr>
<td>Weight</td>
<td>0.116</td>
<td>0.195</td>
<td>0.067</td>
<td>0.800</td>
<td>0.200</td>
</tr>
<tr>
<td>Index</td>
<td>B16</td>
<td>B17</td>
<td>B18</td>
<td>B19</td>
<td>B20</td>
</tr>
<tr>
<td>Weight</td>
<td>0.169</td>
<td>0.447</td>
<td>0.384</td>
<td>0.200</td>
<td>0.500</td>
</tr>
</tbody>
</table>

3. TOPSIS ALGORITHM

There are m goals, n attributes (or evaluation index), and the evaluation value of the first i attribute of the target j is the initial judgment matrix \( V \):

\[
V = \begin{bmatrix}
    x_{11} & x_{12} & \cdots & x_{1n} \\
    x_{21} & x_{22} & \cdots & x_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    x_{m1} & x_{m2} & \cdots & x_{mn}
\end{bmatrix}
\]  

(4)

Step1. Because the dimension of each index may be different, it needs to normalize the decision matrix
Step 2. According to the DELPHI method to obtain the information weight matrix $B$ of the expert group to the attribute, and form the weighted judgment matrix (Zhao, Guo and Yan, 2017)

$$ \mathbf{Z} = \mathbf{V}' \mathbf{B} = \begin{bmatrix}
  x_{11} & x_{12} & \cdots & x_{1n} \\
  x_{21} & x_{22} & \cdots & x_{2n} \\
  \vdots & \vdots & \ddots & \vdots \\
  x_{m1} & x_{m2} & \cdots & x_{mn}
\end{bmatrix}
\begin{bmatrix}
  w_1 & 0 & \cdots & 0 \\
  0 & w_2 & \cdots & 0 \\
  \vdots & \vdots & \ddots & \vdots \\
  0 & 0 & \cdots & w_n
\end{bmatrix}
\begin{bmatrix}
  f_{11} & f_{12} & \cdots & f_{1n} \\
  f_{21} & f_{22} & \cdots & f_{2n} \\
  \vdots & \vdots & \ddots & \vdots \\
  f_{m1} & f_{m2} & \cdots & f_{mn}
\end{bmatrix} $$

$$ X_{ij}^* = x_{ij} / \sqrt{\sum_{k=1}^{m} x_{kj}^2}, \, i=1,2,...,m; \, j=1,2,...,n. \quad (6) $$

Step 3. According to the weighted judgment matrix to obtain the best ideal solution of the evaluation target

Ideal optimal solution

$$ f_j^* = \begin{cases}
  \max(f_{ij}), & j \in J^* \\
  \min(f_{ij}), & j \in J^* \\
\end{cases} \quad j = 1,2,...,n. \quad (8) $$

Ideal worst solution

$$ f_j^* = \begin{cases}
  \min(f_{ij}), & j \in J^* \\
  \max(f_{ij}), & j \in J^* \\
\end{cases} \quad j = 1,2,...,n. \quad (9) $$

Among them, $J^*$ is an incremental index, and $J^*$ is the basic type index

Step 4. The Euclidean distance between the target values and the ideal values is calculated (Zhao, Cai and Cheng, 2017)

$$ S_i^* = \sqrt{\sum_{j=1}^{n} (f_{ij} - f_j^*)^2}, \, j = 1,2,...,n, \quad (10) $$

$$ S_i = \sqrt{\sum_{j=1}^{m} (f_{ij} - f_j)^2}, \, j = 1,2,...,n. \quad (11) $$

Step 5. Calculate the relative closeness of each target

$$ C_i^* = S_i^* / (S_i^* + S_i), i = 1,2,...,m. \quad (12) $$

Step 6. According to the size of the relative closeness, sorting the target, forming the basis of decision, according to the basis of the feasible scheme, and analysis of the advantages and disadvantages of this program.

4. IMPLEMENTATION OF TEACHING EVALUATION OF COMPUTER NETWORK COURSE
Now with 20 evaluation of computer network curriculum teaching of a teachers' evaluation as an example. The evaluation grade is divided into 5 levels, which are excellent, good, pass and fail to produce, teaching evaluation of computer network course for the teacher, which use the digital number of Representatives, such as the indicators of whether the reasonable application of courseware is concerned, there are 6 people considered, 9 people think two, three or four, five, 4, 1, corresponding to the number is 0, the corresponding membership index belong to the five levels of 9/20, followed by 6/20, 4/20, 1/20, 0/20. In this way, the membership degree of each index is obtained directly, and the fuzzy relation matrix is further calculated to obtain the result of fuzzy evaluation.

Teaching evaluation of computer network course involves a wide range, the evaluation content is also very complicated, adopt different indicators can obtain different evaluation results, which requires all aspects of the comprehensive index the further processing of the formation of a more close to the actual evaluation, so as to prevent only in accordance with one or a few indicators that the phenomenon of excessive one-sided evaluation. In order to evaluate the teaching level of computer network course, it is necessary to carry out comprehensive evaluation combined with multiple indexes. The fuzzy comprehensive evaluation method selected in this paper is based on the fuzzy environment, fully considering the influence of various factors, and comprehensively judging someone or something in a certain purpose. The index boundary of the teaching level evaluation of computer network course is fuzzy, and the fuzzy comprehensive evaluation method is used to build the evaluation model, which can fully display the characteristics and laws of classroom teaching. Fuzzy comprehensive evaluation method is a relatively effective evaluation method of multi factor and multi index, the height of the integration of qualitative evaluation and quantitative evaluation, at the same time with the scientific basis of stability, thus obtain scientific and accurate evaluation results.

5. CONCLUSION

Comprehensive evaluation of the teaching method of computer network course, is based on computer network teaching standard, teachers can actively reform the teaching evaluation in accordance with the principle of classroom teaching, improve the teaching level and teaching quality, while the computer network course will not immediately gain comprehensive evaluation of the teaching effect, but reflected in the evaluation process, is beneficial to the teachers continuously improve the teaching curriculum system, computer network teaching evaluation system. In addition, the comprehensive evaluation of computer network course teaching should be closely related to the actual situation, including in-depth analysis of teachers, students and teaching methods. The computer network curriculum teaching evaluation is a very complicated problem, not only need theoretical support, also need to be closely combined with the teaching practice of the further study of computer network teaching evaluation.

Acknowledgements

The work presented in this paper is partially supported by the Zhejiang Provincial Natural Science Foundation of China (Grant No. LY16F010015), and also partially supported by a grant from Public Projects of Wenzhou Science & Technology Bureau (Grant No. G20150020 & No.G20160007).

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