Analysis and Research of Teaching Quality Evaluation System of Colleges and Universities

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Abstract: Teaching quality evaluation is the multi-factor and multi-level complex system. Firstly, the current situation and application of teaching quality evaluation are analysed and summarized based on the literature analysis method and network survey method. Then, the evaluation index system of teaching quality is constructed from five aspects: teaching attitude, teaching design, teaching content, teaching methods and teaching ability. Lastly, the specific weights of each index in the evaluation index system of teaching quality are obtained by numerical simulation analysis. The simulation results show that the constructed model could realize the scientific and reasonable quantitative output of the evaluation results, which provides the basis for the quantitative assessment.

Keywords: Teaching quality; Evaluation indicator; Evaluation system

1. Introduction

With the continuous expansion of the scale of high education, the reform of high education system has continued to deepen, and the construction of teaching quality has been increasingly valued by relevant departments. With the popularization of information-based teaching methods, the education community and related research institutions have actively carried out research and practice on teaching quality evaluation [1-2]. However, the traditional teaching evaluation system mainly performs simple statistics on the original collected feedback data to form evaluation results only about "excellent, qualified, poor", et al. The evaluation results are too broad and general, and cannot be clearly defined. It is difficult to clearly state the level of teaching of a certain teacher or teaching team, which factors are related to the teaching methods, and it is impossible to obtain the effective information to promote education and teaching reform [3]. Therefore, constructing the scientific and quantitative teaching quality evaluation index system is an urgent problem to be solved.

2. Development Status of Teaching Quality Evaluation System in Colleges and Universities

Teaching quality evaluation is the key to measuring the quality of classroom teaching in colleges and universities. In recent years, academic research on the quality of college and universities teaching has become increasingly rich. Many scholars have studied this topic from different angles: Hu put forward a measurement index system for the dimension of teaching quality evaluation of college teachers on the basis of qualitative research [4]. Wang proposed the strategy to reconstruct the teaching evaluation system from the aspects of evaluation purpose, evaluation content, evaluation criteria, evaluation methods and evaluation subjects [5]. Yu put forward the idea that the incentive mechanism needs to be effectively used in the evaluation of teaching quality [6]. Gong clearly stated that the undergraduate teaching quality evaluation system should be included in the students' "study input" and teaching "satisfaction" points [7]. Cai constructed the classroom teaching quality evaluation index system that matched the school's school orientation according to the characteristics of classroom teaching [8]. It can be seen from the relevant research literature that the research on the teaching quality evaluation system at home and abroad is still based on qualitative analysis. The qualitative evaluation teaching evaluation system is difficult to reflect the weight ratio of each teaching factor in the evaluation of teaching quality. And this evaluation method cannot cope with the situation where the amount of data information is large, and there are more restrictions on the scope of promotion and application. For the quantitative analysis method, there are many design requirements for evaluation indicators, especially for the design of the weight of each index factor. At present, there is no clear basis for the relevant contribution, which also brings many difficulties for the scientific and quantitative design teaching quality evaluation index system.

3. Construction of Teaching Quality Evaluation System Model

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International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 3, June, 2019

The evaluation system of teaching quality in colleges and universities is the complex system with multiple levels and multiple indicators. According to the principles of comprehensiveness, rationality and operability, combined with the needs of employers for professional talents, this paper establishes the five-level index structure of the teaching quality evaluation system of colleges and universities from the teaching attitude, teaching design, teaching content, the teaching methods and teaching ability, in which each level index is subdivided into several corresponding second-level indicators according to the actual situation of the teaching. Among the structure of the teaching quality evaluation system the target layer is the teaching quality evaluation system, and the indicators at the factor level are teaching attitude (B1), teaching design (B2), teaching content (B3), teaching method (B4), teaching ability (B5).

4. The Example Simulation and Analysis

4.1. Design of indicator weights for teaching quality evaluation system

According to the concept of the colleges and universities and the actual situation of teaching performance, the importance of each evaluation index used to evaluate the quality of teaching is not the same. Therefore, the reasonable and scientific determination of the weight of each indicator becomes the key to evaluating the quality of teaching. The specific calculation steps are as follows:

Step 1. Construct the judgment matrix for the evaluation index system

In order to improve the rationality and reliability of the judgment matrix data, for the influence the importance of various factors of teaching quality, teachers and undergraduate students participating in the undergraduate teaching activities of the university will be asked after class and questionnaires. In the study course, 400 questionnaires were sent out, and the invalid questionnaires were excluded. The total number of valid questionnaires recovered was 315, and the effective recovery rate was about 79%. After the feedback results and opinions are summarized, the judgment matrix of the target layer and the factor layer in the model obtained are shown as follows:

$$A = \begin{bmatrix} 1 & 4 & 2 & 1/2 & 5 \\ 1/4 & 1 & 1/3 & 1/5 & 1 \\ 1/2 & 3 & 1 & 1/3 & 3 \\ 2 & 5 & 3 & 1 & 5 \\ 1/5 & 1 & 1/3 & 1/5 & 1 \end{bmatrix} \tag{1}$$

$$B_1 = \begin{bmatrix} 1 & 2 & 4 & 1/3 \\ 1/2 & 1 & 3 & 1/4 \\ 1/4 & 1/3 & 1 & 1/5 \\ 3 & 4 & 5 & 1 \end{bmatrix} \tag{2}$$

$$B_2 = \begin{bmatrix} 1 & 4 & 2 & 5 \\ 1/4 & 1 & 1/3 & 2 \\ 1/2 & 3 & 1 & 4 \\ 1/5 & 1/2 & 1/4 & 1 \end{bmatrix} \tag{3}$$

$$B_3 = \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix} \tag{4}$$

$$B_4 = \begin{bmatrix} 1 & 5 & 3 & 7 \\ 1/5 & 1 & 1/3 & 2 \\ 1/3 & 3 & 1 & 5 \\ 1/7 & 1/2 & 1/5 & 1 \end{bmatrix} \tag{5}$$

$$B_5 = \begin{bmatrix} 1 & 4 & 3 \\ 1/4 & 1 & 1/2 \\ 1/3 & 2 & 1 \end{bmatrix} \tag{6}$$

Step 2. Calculate the maximum eigenvalue of the judgment matrix

According to the numerical calculation method of the matrix eigenvalue, the maximum eigenvalue of the judgment matrix is calculated in turn, and the specific steps are as follows:

Multiply each element of each row of the matrix and then open n times to obtain:

$$\bar{\omega}_i = (\prod_{j=1}^{n} a_{ij})^{1/n} \tag{7}$$

In which, i=1,2,…n。

Calculate the approximation of the maximum eigenvalue:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(A\omega)_i}{\omega_i} \tag{8}$$

In which, $(A\omega)_i$ represents the ith element of the vector $(A\omega)$.

The model feature vector value solving steps are as follows:

$\bar{\omega}_1 = \sqrt[5]{1 \times 4 \times 2 \times 1/2 \times 5} = 1.8206$, $\bar{\omega}_2 = 0.4409$, $\bar{\omega}_3 = 1.0845$, $\bar{\omega}_4 = 2.7241$, $\bar{\omega}_5 = 0.4215$ 。

Normalize the feature vector $\bar{\omega} = (\bar{\omega}_1, \bar{\omega}_2, ..., \bar{\omega}_n)^T$ and we get:

$\omega_1 = \frac{\bar{\omega}_1}{\sum \bar{\omega}_i} = 0.2805$, $\omega_2 = 0.0679$, $\omega_3 = 0.1670$, $\omega_4 = 0.4196$, $\omega_5 = 0.0649$ 。

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International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 3, June, 2019

So the sort weight vector for the target layer are as follows:

$$\omega(A) = (0.2805, 0.0679, 0.1670, 0.4196, 0.0649)^{\mathrm{T}} \quad (9)$$

And the maximum eigenvalue of the judgment matrix A:

$$A\omega(A) = \begin{bmatrix} 1 & 4 & 2 & 1/2 & 5 \\ 1/4 & 1 & 1/3 & 1/5 & 1 \\ 1/2 & 3 & 1 & 1/3 & 3 \\ 2 & 5 & 3 & 1 & 5 \\ 1/5 & 1 & 1/3 & 1/5 & 1 \end{bmatrix} \begin{bmatrix} 0.2805 \\ 0.0679 \\ 0.1670 \\ 0.4196 \\ 0.0649 \end{bmatrix} = \begin{bmatrix} 1.4204 \\ 0.3425 \\ 0.8454 \\ 2.1456 \\ 0.3284 \end{bmatrix} \quad (10)$$

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(A\omega)_i}{\omega_i} = \frac{1}{5} \left(\frac{1.4204}{0.2805} + \frac{0.3425}{0.0679} + \frac{0.8454}{0.1670} + \frac{2.1456}{0.4196} + \frac{0.3284}{0.0649} \right) = 5.0688 \quad (11)$$

Step 3. Hierarchical ordering and consistency check

The consistency index of the matrix is taken as $C.I.$, and defined as $C.I. = \frac{\lambda_{\max} - n}{n - 1}$: when $C.I. = 0$, it is considered to have the complete consistency; when $C.I. = 0$, the value of $C.I.$ is larger, it is considered that the worse the consistency of the judgment matrix.

In order to facilitate the consistency of the test matrix, the value of the indicator $C.R.$ is used in the actual calculation process, which is shown as follows:

$$C.R. = \frac{C.I.}{R.I.} \quad (12)$$

In which, the average randomness index is expressed as $R.I.$. At that time, when the judgment matrix $C.R. \leq 0.1$, it is considered that judgment matrix could pass the consistency test, and the corresponding ω is considered as the weight vector.

In the evaluation model proposed in this paper, the consistency test result of matrix A is calculated and the obtained result is shown as follows:

$$C.I.(A) = \frac{\lambda_{\max} - n}{n - 1} = \frac{5.0688 - 5}{5 - 1} = 0.0172 \quad (13)$$

For $n = 5$, check the table and get $R.I. = 1.12$, then

$$C.R.(A) = \frac{C.I.}{R.I.} = \frac{0.0172}{1.12} = 0.0154 \quad (14)$$

From the result of $C.R.(A) = 0.0154 \leq 0.1$, the matrix passes the consistency test and the $\omega(A)$ can be used as the weight vector.

4.2. Analysis of results

In the evaluation of the first-level indicators, according to the ranking results of weights, the weights are ranked from high to low: teaching methods, teaching attitudes, teaching content, teaching design, teaching ability. Among the second-level indicators, the indicators with the highest weight ranking are: the instructive teaching method, the serious teaching attitude, the familiar with teaching materials, advanced and practical method, and the targeted teaching organization. Therefore, it can be obtained that the teaching methods, improvement of the teaching method, serious teaching method, familiar with teaching materials, and the advanced and practical teaching content are the important factors to improve teaching quality.

At the same time, according to the weight of the obtained index layer B relative to the target layer A, the importance of the index B_2 and the index B_5 is small relative to the target layer, and its importance could be negligible. Therefore, in the original data collection phase, specific and complete data information of the three indicators B_1、 B_3 and B_4 can be fully collected, and three specific indicators B_1、 B_3 and B_4 are used as key factors in the teaching quality evaluation system to further improve the pertinence of data speed.

5. Conclusion

The reasonable and objective evaluation of teaching quality is an important guarantee for improving the quality of teaching in colleges and universities, which also points the way forward for the reform of education and teaching in colleges and universities. The model of teaching quality evaluation system proposed in this paper could deeply analyzes the factors affecting teaching quality and obtains key indicators and specific weight values that affect teaching quality. The calculation and analysis process fully reflects the objectivity and impartiality of evaluation. The theory and method of teaching evaluation system research have certain innovation and broad application prospects, and further improve the evaluation system of higher education teaching quality, which provides the reliable implementation basis for scientific and reasonable evaluation of colleges and universities teaching quality. According to the specific weights of the evaluation indicators obtained, the specific reform measures to improve the evaluation of teaching quality are proposed from the establishment of professional evaluation team, the formation of a diversified evaluation mechanism, and further clarify the importance of teaching quality evaluation work.

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