

Evaluation Model for Applied College Teachers' Social Responsibility Based on Fuzzy Synthetic Evaluation Method

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Abstract- The social responsibility of university teachers directly determines the quality and level of education and its training objects. This paper takes the social responsibility of university teachers as the research object, and establishes an evaluation model to evaluate it systematically. Based on the analysis of the basic requirements of Applied University teachers, this paper clarifies the role orientation and responsibility requirements of teachers, and puts forward the research theme of teachers' sense of responsibility as the endogenous motive force and spiritual pillar for teachers to carry out all their work. Following the principle of combining scientificity, feasibility, independence, quantity and quality, the evaluation index system of social responsibility of university teachers is designed. Based on the fuzzy comprehensive evaluation method, the evaluation model is constructed from the four dimensions of teachers' knowledge and skills, teaching ability, personal quality and personality charm, which provides a theoretical basis for solving the problem of comprehensive evaluation and provides a basis for decision makers a simple and effective method of evaluation and decision-making.

Key words: *University teachers; social responsibility; index system; fuzzy comprehensive evaluation method*

I. INTRODUCTION

Being different from undergraduate colleges and universities with scientific research as their orientation, application-oriented universities refer to the educational institutions with training of applied talents and undergraduate education as their main orientation to meet the needs of the society for high-level applied talents and play an active role in promoting the process of popularization of higher education in China.

The concept of teacher development in applied universities reflects the educational function of applied higher education and the basic characteristics of the development of university teachers in current situation [1]. It has a decisive impact on the development of teachers and schools. The function, mission and value of applied university teachers in education and development activities are worth discussing [2].

Among all the quality requirements, teachers' sense of social responsibility is the most important factor, which is the original intention of this study [3] [4]. Through the design of evaluation index system and the construction of evaluation

model, the social responsibility of applied teachers in higher education is analyzed in this paper in order to provide theoretical basis and data support for the progress of teachers and the development of education.

II. BASIC REQUIREMENTS OF APPLIED COLLEGE TEACHERS

A big number of high-quality applied talents are needed in China's economic construction and social development. In order to meet the requirement of practical personnel' training, many newly-built undergraduate colleges and universities in China have gradually transformed into application-oriented colleges and universities [5].

Currently, scholars at home and abroad have different opinions on the definition of applied universities, and there is no unified conclusion. In the decision of the State Council on Accelerating the Development of Modern Vocational Education, the universities of applied technology vocational education at undergraduate level are called applied universities.

Different from research or academic universities, application-oriented universities aim at training applied talents and serving local economic development, and accordingly set up specialties, adjust curriculum system, revise personnel training programs and reconstruct teacher team [6].

Teachers belong to the most basic role groups in colleges and universities [7]. They are the key to the survival and development of schools and have great responsibilities. The main way for universities to assume social responsibility is to fulfill it through the work activities of university teachers. College teachers should not only ensure the scientific research of professional knowledge and standardized classroom teaching activities, but also pay attention to the impact of the results of these teaching and research work on society, that is, the social responsibility of college teachers [8]. Teacher's sense of responsibility is the endogenous motivation and spiritual pillar for teachers to carry out all their work [9].

Because of the characteristics of university teachers' work, the influence of university teachers on society is getting greater. However, the phenomenon of teachers' social responsibility weakening also exists due to the influence of

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social environment, which is embodied in that some teachers lack personal professional ethics which may endanger students, focus only on money but ignore the improvement of knowledge and skills, treat teaching process and other acts perfunctorily. So, it is necessary to establish a scientific and reliable evaluation and a price standard to judge and restrict the fulfillment of social responsibility of university teachers [10].

This paper uses a method of fuzzy synthetic evaluation to evaluate the social responsibility of university teachers, which has strong social value and practical significance.

III. CONSTRUCTING A EVALUATION INDEX SYSTEM OF SOCIAL RESPONSIBILITY OF TEACHERS

The establishment of the index system must follow certain principles. Following the principles of scientific, feasibility, independence, as well as the combination of quantitative and qualitative, through consulting a large number of documents and field surveys, this paper determines that the social responsibility of university teachers is evaluated from four dimensions: knowledge and skills, teaching ability, personal quality and personality charm.

TABLE I. EVALUATION INDEX SYSTEM OF SOCIAL RESPONSIBILITY OF TEACHERS

Evaluation Index System of Teachers' Social Responsibility in Applied Universities U	First level Index	Second level Index	Index description
	U_1	Knowledge and skills	professional knowledge u_{11}
Scientific research level u_{12}			Academic papers, projects, textbooks, monographs, patents, awards for scientific research
learning ability u_{13}			Ability to learn professional knowledge and other new knowledge
Innovation ability u_{14}			Innovation Awareness, Innovation Ability and Innovation Achievements
U_2	Teaching ability	Teaching preparation u_{21}	Whether to adjust teaching calendar, teaching plan, PPT and class mentality before class
		Teaching process u_{22}	Whether the teaching methods are appropriate, the classroom atmosphere is good, and the language expression is clear or not
		Teaching achievement u_{23}	Student achievement, student satisfaction, teaching awards, teaching and research topics
U_3	Personal quality	Professional quality u_{31}	Qualifications and ethics as a qualified teacher
		Dedication spirit u_{32}	Input and selflessness in teachers' work
		Moral character u_{33}	Teachers' personal ideological, political and behavioral qualities
U_4	Personality charm	Self-confidence u_{41}	Self-understanding and self-evaluation of Abilities of the Teachers
		Fulfillment u_{42}	Sense of pleasure or success in the work of teachers
		Effect u_{43}	Teachers influence students and colleagues through personal charm

IV. CONSTRUCTION OF THE EVALUATION MODEL OF TEACHERS' SOCIAL RESPONSIBILITY

Based on the fuzzy comprehensive evaluation method, this paper constructs a model to evaluate the social responsibility of University teachers [11]. Fuzzy synthetic evaluation method provides a theoretical basis for solving the problem of comprehensive evaluation, and finds a simple and effective assessment and policy making way for decision makers. The principle of fuzzy synthetic evaluation is to divide the key factors affecting the evaluation object into several categories according to their characteristics, and to divide each category into several key single factors according to its attributes, and then to give a result of elementary comprehensive evaluation of each category, and finally to make a high-level

comprehensive evaluation of the primary evaluation results, so as to get the evaluation status of the object.

This paper adopts the two-level fuzzy comprehensive evaluation method, by combining it with Analytic Hierarchy Process (abbreviated as AHP) to determine the index weight so as to complete the estimating process [12]. AHP is proposed by Professor Sarty, an American operational research scientist of the University of Pittsburgh [13]. It refers to the decision-making method that divides the elements related to the decision-making goal into the target level, the criterion level and the scheme level, on which the qualitative and quantitative analysis is carried out.

A. Establishing a collection of comments

According to the method of historical data, this paper divides the social responsibility levels corresponding to each index of university teachers into: very strong, strong, general, poor, very poor, and establishes a commentary set as follows:

$$V = \{ V_1, V_2, V_3, \dots, V_m \}$$

$$= \{ \text{Very strong, strong, General, Poor, Very Poor} \}$$

B. Establishing Evaluation Matrix

To establish an evaluation matrix, the first thing is to determine the membership degree of the single-factor evaluation index. The specific steps are as follows: firstly, invite a number of experts (n) to select the best one (in his opinion) among the single-factor index to give a description and evaluation of it, presented as

$$V_k (k = 1, 2, 3, \dots, m).$$

And then count the number of times

$N_k (N_k = 1, 2, 3, \dots, n)$ that each evaluation V_k of the index selected, and thus get the membership degree Nk/n of the index u_{ij} to the evaluation V_k .

This paper invites 10 experts who are closely related to the assessed, including their superiors, peers, themselves and students. According to the actual situation of the evaluation object, the membership degree of each single factor index is determined and the evaluation matrix is established.

The evaluation matrix is presented below:

1) Evaluation Matrix of Secondary Indicators of Knowledge and Skills

$$R1 = \begin{bmatrix} 0.2 & 0.3 & 0.3 & 0.2 & 0.0 \\ 0.1 & 0.1 & 0.6 & 0.2 & 0.0 \\ 0.1 & 0.2 & 0.5 & 0.2 & 0.0 \\ 0.0 & 0.3 & 0.5 & 0.2 & 0.0 \end{bmatrix}$$

2) Evaluation Matrix of Secondary Indicators of Teaching Ability

$$R2 = \begin{bmatrix} 0.2 & 0.4 & 0.3 & 0.1 & 0.0 \\ 0.1 & 0.3 & 0.5 & 0.1 & 0.0 \\ 0.0 & 0.5 & 0.3 & 0.2 & 0.0 \end{bmatrix}$$

3) Evaluation Matrix of Secondary Indicators of Personal Quality

$$R3 = \begin{bmatrix} 0.2 & 0.5 & 0.2 & 0.1 & 0.0 \\ 0.0 & 0.4 & 0.5 & 0.1 & 0.0 \\ 0.2 & 0.5 & 0.2 & 0.1 & 0.0 \end{bmatrix}$$

4) Evaluation Matrix of Secondary Indicators of Personality Charm

$$R4 = \begin{bmatrix} 0.1 & 0.3 & 0.3 & 0.3 & 0.0 \\ 0.1 & 0.5 & 0.2 & 0.1 & 0.0 \\ 0.1 & 0.3 & 0.3 & 0.3 & 0.0 \end{bmatrix}$$

C. Weight Determination

There are many methods to determine the weight. Because the evaluation index system of social responsibility of applied university teachers established in this paper is a multi-level structure, we choose the analytic hierarchy process to determine the weight of each index.

Analytic Hierarchy Process (AHP) is a decision-making method that divides the relevant elements of decision-making problems into several levels, and then carries out quantitative and qualitative analysis on the basis of it. The specific process of weight determination is described below.

1) Construction of comparison matrix

According to the evaluation index system, each index subordinate to the same index is compared with each other to determine the relative importance of each index and form a judgment matrix. Assuming that the index of the upper level is the criterion level, it has a dominant effect on the index of the lower level. To decide the relative importance of the two elements by expert scoring, the 1-9 scale method is adopted, whose specific meaning is as follows:

TABLE II. SCALE AND MEANING OF JUDGMENT MATRIX 1-9

Scale	Meaning
1	two factors have the same importance as each other.
3	one factor is slightly more important than the other.
5	one factor is significantly more important than the other.
7	one factor is strongly important than the other.
9	one factor is extremely important than the other.
2, 4	The median of the above two adjacent judgements
6, 8	The median of the above two adjacent judgements
Reciprocal	If the comparison of factors i with j is defined as b_{ij} , then the comparison of factors j with i is $b_{ji} = 1/b_{ij}$

Before determining the judgment matrix, it is necessary to rank the importance degree of each sub-index belonging to the same index in order to avoid contradictions, but the process of ranking and determining the scale value of importance degree is more subjective. Therefore, this paper through consulting and analyzing a large number of relevant literature, and according to the views and suggestions of some experts, finally determines the importance ranking of each index add scaling values.

Therefore, by consulting and analyzing a large number of relevant literature, and according to the views and suggestions of the invited experts, this paper finally determined the importance of each index ranking and scaling value.

The comparison matrix values of each index are as follows:

Comparison Matrix of First-Level Indicators of Evaluation Objectives

$$U = \begin{bmatrix} 1.000 & 0.500 & 0.333 & 2.000 \\ 2.000 & 1.000 & 0.500 & 4.000 \\ 3.000 & 2.000 & 1.000 & 4.000 \\ 0.500 & 0.250 & 0.250 & 1.000 \end{bmatrix}$$

Comparative Matrix of Secondary Indicators of Knowledge and Skills

$$U_1 = \begin{bmatrix} 1.000 & 2.000 & 4.000 & 3.000 \\ 0.500 & 1.000 & 3.000 & 2.000 \\ 0.250 & 0.250 & 1.000 & 0.500 \\ 0.333 & 0.500 & 2.000 & 1.000 \end{bmatrix}$$

Comparing Matrix of Secondary Indicators of Teaching Ability

$$U_2 = \begin{bmatrix} 1.000 & 2.000 & 4.000 \\ 0.500 & 1.000 & 3.000 \\ 0.250 & 0.250 & 1.000 \end{bmatrix}$$

Comparison Matrix of Secondary Indicators of Individual Quality

$$U_3 = \begin{bmatrix} 1.000 & 5.000 & 3.000 \\ 0.200 & 1.000 & 0.333 \\ 0.333 & 3.000 & 1.000 \end{bmatrix}$$

TABLE III. TABLE 3 THE VALUE OF RI

$$U_4 = \begin{bmatrix} 1.000 & 0.333 & 0.167 \\ 3.000 & 1.000 & 0.250 \\ 6.000 & 4.000 & 1.000 \end{bmatrix}$$

Order of Judgment Matrix <i>n</i>	1	2	3	4	5	6	7	8	9	10
<i>RI</i>	0.00	0.00	0.58	0.90	1.12	1.24	1.34	1.41	1.45	1.49

From the above steps, it can be calculated that:

(1) Determining the weights of the first-level indicators

Comparison Matrix of Secondary Indicators of Personality Charm

2) Hierarchical ranking and consistency test

This paper uses the square root method to calculate the weight. The concrete steps are shown below:

- First, the product of each row of the comparison matrix is computed. $M_i = \prod_{j=1}^n a_{ij} \quad (i=1,2,3 \dots n)$
- Then, calculate the *n* square root of the product M_i of each row. $\bar{w}_i = \sqrt[n]{M_i}$
- Normalization of vectors $\bar{w} = (\bar{w}_1, \bar{w}_2, \dots, \bar{w}_n)$, to get: $w_i = \bar{w}_i / \sum_{i=1}^n \bar{w}_i \quad (i=1,2,3 \dots n)$, w_i is the weight of relative importance of each index.
- In order to ensure the consistency and reliability of the judgment matrix, it is necessary to pass the consistency test. From $Aw^T = \lambda w^T$, we can get the maximum eigenvalue of judgment matrix

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{(Aw^T)_i}{w_i}$$

Then we can get the value of *CI* and *CR*.

Both *CI* and *CR* are consistency test index, where *CI* is indicators of consistency, while *CR* represent the random consistency ratio.

where: $CI = \frac{\lambda_{\max} - n}{n - 1}$, $CR = \frac{CI}{RI}$

When $CR < 0.10$, it is considered that the consistency of the results is satisfactory; otherwise, the values of the elements of the judgment matrix need to be readjusted until satisfactory. It is a random consistency index whose values are shown in Table 3.

of evaluation objectives:

$$w = (0.158, 0.294, 0.460, 0.087),$$

$$CI = 0.015, CR = 0.017, CR < 0.10,$$

It shows that the comparative matrix is consistent. It can be seen that the importance of the first-level indicators ranks from strong to weak in terms of personal quality, educational ability and personality charm of knowledge and skills.

(2) Determining the weights of secondary indicators of knowledge and skills:

$$w_1 = (0.470, 0.279, 0.089, 0.161),$$

$$CI_1 = 0.010, CR_1 = 0.011, CR_1 < 0.10,$$

It presents that the comparative matrix is consistent. It can be seen that the second-level indicators of knowledge and skills rank from strong to weak in terms of professional knowledge, scientific research level, innovation ability and learning ability.

(3) Determining the weight of the secondary indicators of teaching ability:

$$w_2 = (0.097, 0.570, 0.333),$$

$$CI_2 = 0.012, CR_2 = 0.021, CR_2 < 0.10,$$

It proves that the comparative matrix has consistency. It can be seen that the importance of secondary indicators of teaching ability ranks from strong to weak in order of teaching process, teaching results and teaching preparation.

(4) Determining the weight of the secondary indicators of personal quality:

$$w_3 = (0.637, 0.105, 0.258),$$

$$CI_3 = 0.019, CR_3 = 0.033; CR_3 < 0.10,$$

It means that the comparative matrix has consistency. It can be seen that the second-level indicators of personal quality rank from strong to weak in terms of professional quality, moral quality and dedication.

(5) The determination of the weight of the secondary indices of personality charm:

$$w_4 = (0.091, 0.218, 0.691),$$

$$CI_4 = 0.027, CR_4 = 0.046; CR_4 < 0.10,$$

It implies that the comparative matrix has consistency. It can be seen that the secondary indices of personality charm rank from strong to weak in order of influence, sense of achievement and self-confidence.

D. First-level Fuzzy Comprehensive Evaluation

The first-level fuzzy comprehensive evaluation of U_i is: $B_i = w_i R_i$, According to the formula, the results of the first-level fuzzy comprehensive evaluation are as follows.

The weights w_1 and evaluation matrices R_1 of the second-level indicators of knowledge and skills calculated above is obtained, as:

$$B_1 = w_1 R_1 = (0.470, 0.279, 0.089, 0.161)$$

$$\begin{bmatrix} 0.2 & 0.3 & 0.3 & 0.2 & 0.0 \\ 0.1 & 0.1 & 0.6 & 0.2 & 0.0 \\ 0.1 & 0.2 & 0.5 & 0.2 & 0.0 \\ 0.0 & 0.3 & 0.5 & 0.2 & 0.0 \end{bmatrix}$$

$$= (0.131, 0.235, 0.433, 0.200, 0)$$

Similarly, the following ones can be got:

$$B_2 = w_2 R_2 = (0.08, 0.38, 0.41, 0.13, 0)$$

$$B_3 = w_3 R_3 = (0.18, 0.49, 0.23, 0.10, 0)$$

$$B_4 = w_4 R_4 = (0.10, 0.34, 0.28, 0.26, 0)$$

E. Secondary Fuzzy Comprehensive Evaluation

To get the final evaluation vector of U ,

the evaluation results B_i^* are taken as the evaluation matrix U , that is:

$$R = \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{bmatrix} = \begin{bmatrix} 0.13 & 0.24 & 0.43 & 0.20 & 0 \\ 0.08 & 0.38 & 0.41 & 0.13 & 0 \\ 0.18 & 0.49 & 0.23 & 0.10 & 0 \\ 0.10 & 0.34 & 0.28 & 0.26 & 0 \end{bmatrix}$$

According to the weight of evaluation target index obtained above, $w = (0.158, 0.294, 0.460, 0.087)$,

The final result is:

$$B = wR = (0.13, 0.40, 0.32, 0.14, 0).$$

V. CONCLUSION

The paper analyzes the evaluation results of teachers' social responsibility in applied universities.

The evaluation results indicate that 13% of the teachers can be sure of their strong sense of social responsibility; 40% of the them are of their relatively strong sense of social responsibility; 32% of the teachers have a general sense of social responsibility; 14% of the teachers surely have a poor sense of social responsibility; and none of them is proved have no or very poor sense of social responsibility. According to the principle of maximum membership, it can be determined that the social responsibility of the evaluated person of the university staff is strong, and the evaluation results are basically consistent with the actual situation of the teacher.

Along with the change of the times, of course, the criteria for evaluating teachers' social responsibility in applied colleges and universities will change accordingly. Each college should adjust its evaluation index or weight properly according to its own situation. Only through constant adjustment and enrichment, can the process of evaluating teachers' social responsibility in colleges and universities be more standardized and scientific, thus realizing social responsibility of teachers in colleges and universities and

maximizing their social functions.

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