International Journal of Innovation and Research in Educational Sciences
Volume 6, Issue 2, ISSN (Online) : 2349–5219

Research on the Promotion System of University Teachers' Titles Based on Analytic Hierarchy Process

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Date of publication (dd/mm/yyyy): 13/04/2019

***Abstract* – Although China has a relatively complete system of promotion of teacher titles, it still reflects some problems and deficiencies in specific practical operations to improve this situation. This paper will use the analytic hierarchy process to objectively determine the proportion of different indicators in the professional title evaluation system. By more specifically quantifying the weight of each indicator, college teachers are strictly divided into research-oriented talents and teaching-oriented talents to determine the promotion of college teachers' titles. This paper hopes to build a relatively scientific, comprehensive, reasonable, fair and just promotion evaluation system, which provides better suggestions for the better development of college teachers' title promotion system.**

***Keywords* – College Teacher Title Promotion System; Analytic Hierarchy Process; Comprehensive Weight.**

I. Introduction

Because the promotion of college teachers' titles is highly policy-oriented, and it is scientific, fair, and reasonable, it is related to whether it can mobilize the enthusiasm and creativity of teachers, and it is related to the construction of teachers, the adjustment of academic echelons, and the promotion of higher education. Sustainable development is of great significance. Therefore, it is especially necessary to establish a relatively fair teacher title appraisal system. This paper attempts to analyze the problem by using the analytic hierarchy process. After understanding the qualifications of a university's teacher title promotion and recruitment [1], and consulting the relevant literature, the four assessment indicators and sub-indicators for the promotion of the title level were refined, and two sets of teaching talents and scientific research talents were strictly given. Different evaluation and recruitment systems, comprehensive use of the analytic hierarchy process to build a system of evaluation and promotion of college teachers' titles.

II. Election and Inspection of Indicators for Job Title Evaluation System

1. *Selection of Evaluation System Indicators:*

After understanding the conditions for the promotion of the title of a university teacher in the country and consulting the relevant literature, we selected the following indicators as the basis for establishing the evaluation system. Therefore, the hierarchical structure chart of the title evaluation system [2] was established, as follows:

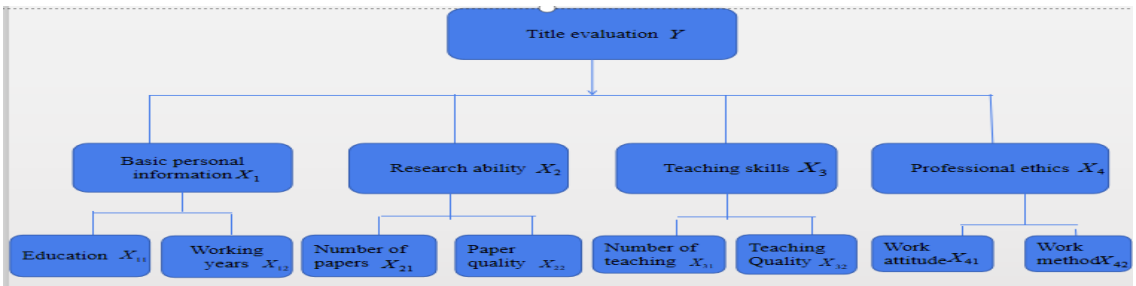

Fig. 1. Hierarchical structure of the title evaluation system.

As shown in the above figure, we divide the factors affecting job title assessment into two layers. The first layer is the four main factor indicators, which are individual basic situation, scientific research ability, teaching ability, professional ethics, expressed by vector $X=(X_1, X_2, X_3, X_4)$, each component the corresponding weight is represented by vector $x = (x_1, x_2, x_3, x_4)$ .The second layer of measurement indicators is to subdivide the factors of the first layer [3], and each level factor is divided into two second-level factors, namely, education, working years, number of papers, quality of papers, number of teaching , teaching quality, work attitude, working method, expressed by vector $X^{'} = (X_{11}, X_{12}, X_{21}, X_{22}, X_{31}, X_{32}, X_{41}, X_{42})$, wherein the weight vector of the second factor in factor X_i is represented by $x_{ij} = (x_{i1}, x_{i2})$.

2. *Analytic Hierarchy Process and Consistency Test*

(1) *Consistency test:*

Using the eigenvector method to solve and sort consistency test [3], the formula for calculating this index is as follows:

$$CI = \frac{\lambda - n}{n - 1}$$

A random consistency indicator was introduced, as shown in the following table:

Table 2. Random consistency indicator values.

n	3	4	5	6	7	8	9	10
RI	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

After calculating the consistency index CI of the n-order pairwise comparison matrix A in practical applications, compared with the random consistency index RI of the same order, the ratio $CR=\frac{CI}{RI} < 0.1$ is considered to pass.

Note that when $n = 2$, the pairwise comparison matrix is always a uniform array [4]. The purpose of our consistency check is to test the rationality of the selected indicators, rather than to test the final results.

III. THE CONSTRUCTION OF COLLEGE TEACHER TITLE PROMOTION SYSTEM

We have built an index system for job title evaluation, and introduced the analytic hierarchy process when determining the weight of indicators [5]. It is worth noting that the tasks undertaken by college teachers are different. Some teachers belong to scientific research talents, and some teachers belong to teaching talents. However, no matter which type, in the evaluation of professional titles, some hard indicators must be met, such as the requirements of teaching time. Therefore, considering the above analysis, we have introduced two evaluation index systems when establishing the pairwise comparison matrix:

1. *Teaching Talent:*

$$A = \begin{pmatrix} 1 & 3/7 & 3/5 & 2/1 \\ 7/3 & 1 & 5/3 & 4/1 \\ 5/3 & 3/5 & 1 & 3/1 \\ 1/2 & 1/4 & 1/3 & 1 \end{pmatrix}$$

Among them, the column and line indicators are the basic situation of the individual, teaching, scientific research, and professional ethics.

The consistency check is performed on the pairwise comparison matrix and the weight vector is calculated. The results are as follows:

$\lambda_{\max} = 4.0072$, consistency index $CI = 0.0024$, consistency ratio $CR = 0.0027$, passed the consistency test, the weight vector is: $x = (0.1839, 0.4318, 0.2860, 0.0982)$.

2. *Research Talents:*

$$A = \begin{pmatrix} 1 & 3/5 & 3/7 & 2/1 \\ 5/3 & 1 & 3/5 & 3/1 \\ 7/3 & 5/3 & 1 & 4/1 \\ 1/2 & 1/3 & 1/4 & 1 \end{pmatrix}$$

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Therefore, we have established two job title evaluation system, which are applicable to scientific research and teaching talents [6]. Next, we need to refine the criteria layer and establish the weight relationship of the sub-criteria layer.

1. *Pairwise Comparison Matrix of Sub-Criteria Layers*:

Research Talents:

$$A_1 = \begin{pmatrix} 1 & 2/1 \\ 1/2 & 1 \end{pmatrix}, A_2 = \begin{pmatrix} 1 & 1/3 \\ 3 & 1 \end{pmatrix}, A_3 = \begin{pmatrix} 1 & 1/2 \\ 2 & 1 \end{pmatrix}, A_4 = \begin{pmatrix} 1 & 1/2 \\ 2 & 1 \end{pmatrix},$$

The indicators represented by each matrix are shown in Figure 1, and the second-order matrix always passes the consistency test. The weight vector is given below.

$$x_1 = (0.6667, 0.3333),\ x_2 = (0.25, 0.75),\ x_3 = (0.3333, 0.6667),\ x_4 = (0.3333, 0.6667).$$

Table 3. Teaching type comprehensive weight.

Main factor layer	Weights	Sub-factor layer	Weight 2	Comprehensive weight
Basic personal information	0.1839	Education	0.6667	0.1226
		Working years	0.3333	0.0613
Research ability	0.4318	Number of papers	0.25	0.1080
		Paper quality	0.75	0.3238

Teaching skills	0.2860	Number of teaching	0.3333	0.0953
		Teaching Quality	0.6667	0.1907
Professional ethics	0.0982	Work attitude	0.3333	0.0327
		Work method	0.6667	0.0655

Teaching Talent:

$$A_1 = \begin{pmatrix} 1 & 2/1 \\ 1/2 & 1 \end{pmatrix}, A_2 = \begin{pmatrix} 1 & 1/2 \\ 2 & 1 \end{pmatrix}, A_3 = \begin{pmatrix} 1 & 1/3 \\ 3 & 1 \end{pmatrix}, A_4 = \begin{pmatrix} 1 & 1/2 \\ 2 & 1 \end{pmatrix},$$

The indicators represented by each matrix are shown in Figure 1, and the second-order matrix always passes the consistency test. The weight vector is given below.

$$x_1 = (0.6667, 0.3333),\ x_2 = (0.3333, 0.6667)\ x_3 = (0.25, 0.75),\ x_4 = (0.3333, 0.6667)$$

Table 4. Scientific research comprehensive weight.

Main factor layer	Weights	Sub-factor layer	Weight 2	Comprehensive weight
Basic personal information	0.1839	Education	0.6667	0.1226
		Working years	0.3333	0.0613
Research ability	0.2860	Number of papers	0.3333	0.0953
		Paper quality	0.6667	0.1907
Teaching skills	0.4318	Number of teaching	0.25	0.1080
		Teaching Quality	0.75	0.3238
Professional ethics	0.0982	Work attitude	0.3333	0.0327
		Work method	0.6667	0.0655

Through the comparison of the teaching-type comprehensive weights and the scientific research-type comprehensive weights, we can more objectively determine the proportion of different indicators in the professional title evaluation system [7], and can more deeply understand the difference between scientific research talents and teaching talents.

IV. CONCLUSION

Through the research on the promotion system of college teachers' titles, we know that in the evaluation of teachers' titles, we must strictly distinguish between teaching talents and scientific research talents. Any institution of higher learning should have its own position and need to define its own development advantages. However, an important task of colleges and universities is to cultivate the high-level talents needed for modernization. Therefore, teaching needs are the primary problem that colleges and universities need to solve. Under the current system, the title evaluation system pays too much attention to scientific research and neglects teaching. This is not correct. The examination of teaching talents should be diversified. Secondly, strictly control the number and quality of scientific research talents. This paper constructs a relatively scientific, comprehensive, reasonable, fair and fair promotion assessment, and more specifically quantifies the weight of each indicator, which provides better suggestions for the better development of the university teacher title promotion system. Since the work of

teachers in each university is different, further exploration is needed in terms of index selection and weight difference design to ensure that the better development of college teachers' title promotion system can fully improve teachers' enthusiasm for work and loyalty to positions.

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