

Study on Evaluation System for the Quality of Teachers in Chinese Universities

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Abstract: With the deeper development of economy, the requirement for the high-quality talents increases. To meet the demand of social development, the government and university all want to produce the high-quality of teachers that cultivate the high-quality talents. As a prerequisite, it is imperative to establish a reasonable and scientific evaluation system for the teacher quality. In this paper, we analyze the core of five indicators (responsibility, professional level, work performance, moral conduct, work willingness) that affect the quality index of college teachers by using rough set theory and combine gray correlation theory to identify correlation of important indexes for the evaluation of teacher quality. The results remove the redundant evaluation indicators and indicate that the bigger gray correlation degrees of evaluation indexes mean the better comprehensive quality of teacher. The research is beneficial for Chinese universities to improve the teacher quality, and ultimately, to improve the comprehensive strength of universities.

Keywords: Quality of teachers; Rough set; Gray correlation degree; Comprehensive evaluations

1 Introduction

The Chinese contemporary higher education has gone through a process for 30 years. Its development and reform have achieved some progress to a certain degree. In the course of Chinese modernization, education is increasingly becoming the strong power and important resources. Meanwhile, education confronts great crisis and challenge. Reform and update as important issues in China's higher education are not only the key to breakthrough bottleneck of current education but also the way to achieve socialist modernization goal. Faced with more and more fierce international competition, it is urgent to cultivate a group of high-quality talent in this high-tech era of economic globalization, knowledge economization and international exchange. It is worth nothing that the talent cultivation is tightly connected with the guidance of teacher. Teacher quality is the active and decisive factor for quality-oriented education [1]. The indicators affecting evaluation of the faculty quality are large, mainly including responsibility, professional level, work performance, ethical practice and willingness to work and so on. In order to improve teacher quality pointedly, confirming the main indicators of teacher quality evaluation and its important degree are crucial to promote teacher quality quickly and effectively.

Polish mathematician Z.Pawlak first brought forward the rough set theory in 1982 and aroused a wide attention [2]. It mainly concentrated on algebraic structure and logic research in theory. In China, rough set theory once again became a hot topic because of the further study by Wenxiu Zhang [3], who made the theory widely used in competency evaluation method for teachers. Yan et al.(2006) elaborated the basic concept of rough set and built rough-set comprehensive evaluation method [4]. This method could make teachers evaluation reflect comprehensive ability accurately and scientifically. What's more, in terms of mobilizing teachers' enthusiasm on self awareness, the feasibility and practicality are verified through examples. In order to focus on the comprehensive evaluation of university teachers' quality, Wang et al.(2012) proposed a new algorithm based on rough set theory and correlation analysis of selected main factors, which eliminated the drawback of experts subjective judgment [5]. The evaluation of teacher quality affected by many factors, some of which are indifferent. Screening out major factors affecting teachers' quality evaluation is necessary and significant.

Chinese research Julong Deng put forward Grey system theory in 1982 for the first time, which was used in many fields of society, agriculture, engineering, economic management control [6–8]. The work had been hailed as a significant

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development of one of the natural science discipline [9]. The research of gray theory includes gray idea, gray generation, gray mathematics, gray relational analysis. Gray theory is applied broadly in evaluation of teacher quality. Hua Huang used the multilevel gray theory to establish teachers' performance evaluation model based on the major three tasks of teachers' quality requirements, namely, teaching, scientific research and social services [10]. The model made the evaluation of teachers' performance more scientific, objective and reasonable. Similarly, Zhitong Ding built the quality performance evaluation system for the teachers in colleges and universities by using multi-level gray evaluation method from the perspective of multi-dimension and multi-level [11]. The aim of research was to improve the teaching staff construction, especially the key teaching stuff development. Actually, in order to make assessment result more accurate, we should avoid weak and redundant factors during the process of evaluation.

In this paper, we first select important indexes that influence the evaluation of teacher quality profoundly based on the rough set theory. Then the correlation of important indexes for teacher quality evaluation would be explored according to gray correlation theory. Finally, the method of comprehensive assessment on teacher quality are analyzed. The paper is organized as follows: in section 2, the evaluation method based on rough set theory is introduced. Section 3 describes gray correlation analysis and discuss the result. Section 4 concludes the paper.

2 Teacher quality evaluation based on rough set theory

Within the rough set theory the pair $K = (U, R)$ forms an information system, where U is a non-empty finite set of objects, and R is a family of equivalence relation in U [12]. Each non-empty finite set $X \subseteq U$ is called concept or category in U .

Let a information system $S = (U, C)$ and denote C as $C = (C_1 C_2 C_3)$. If $U/(C - C_1) \neq U/C$, C_1 is necessary in S and defined as one of core in C . A set of all necessary information in C is called core.

$$B = COREC \tag{1}$$

Information system $IS = (U, C, V, F)$. For each core $\forall B \subseteq C$ and object $\forall \alpha \in C - B$, attribute importance can be defined as (2):

$$sig(\alpha, B; C) = \frac{|POS_{(B \cup \alpha)}(C)| - |POS_B(C)|}{|U|} \tag{2}$$

where $|U|$ is the number of element in U , $|POS_B(C)|$ denotes the number of element in $POS_B(C)$.

The factors that influence teacher quality evaluation in a university and its data are shown in Table 1 [13]. Comprehensive evaluation indexes of teacher quality include sense of responsibility, professional level, work performance, moral conduct and working willingness.

The data in Table 1 under contraction is shown in table 2. The indexes of teacher evaluation are divided into different intervals, which have different code attribute values. $C_i (i = 1, 2...5)$ represent sense of responsibility, professional level, work performance, moral conduct and working willingness respectively.

Core and attribute importance of each evaluation index are calculated by using equations (1),(2).

$$U/C = [(1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13) (14) (15) (16) (17) (18)] \tag{3}$$

$$U/C - C_1 = [(1) (2) (3) (4 18) (5 9) (6) (7) (8) (10) (11) (12) (13) (14) (15) (16) (17)] \neq U/C \tag{4}$$

C_1 is necessary. The same procedure may be applied to obtain C_3 easily, C_5 is necessary in C and C_2, C_4 are not necessary.

$$B = CORE(C) = (C_1, C_3, C_5) \tag{5}$$

$$POS_{B \cup C_2}(C) = [(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12), (13) (14) (15) (16) (17) (18)] \tag{6}$$

$$POS_B(C) = [(1) (2) (3) (5) (6) (8) (9) (10) (13) (14) (15) (16) (17) (18)] \tag{7}$$

Table 1: The indexes of teacher evaluation and its value

Numbers	responsibility	professional level	Work performance	Moral conduct	Work willingness
1	22.5	14.3	14.5	14.2	7.2
2	26.3	16.7	16.3	16.2	8.3
3	27.4	17.4	17.6	17.6	9.3
4	28.4	18.6	18.7	18.5	9.4
5	24.2	14.8	14.4	14.8	8.4
6	26.3	15.5	16.1	15.7	8.2
7	24.9	14.6	15.1	14.8	7.7
8	25.3	15.5	15.7	16.0	8.5
9	28.1	18.4	18.3	18.4	9.1
10	28.2	18.5	18.8	18.8	9.5
11	24.7	15.3	15.1	14.8	8.0
12	27.4	17.0	17.2	16.9	8.9
13	28.5	18.3	18.4	18.7	9.3
14	26.5	17	15.2	18.2	8.1
15	27.1	26.5	17.2	14.8	8
16	28	18.1	17.9	16.8	7.9
17	25.2	17.6	18.8	15.8	8.5
18	25.3	17.5	16.2	16.5	8.3
19	24.8	18	17.1	16.2	8.1
20	28	15.8	16.1	15.2	8.1

Table 2: Decision table after simplification

Numbers	C_1	C_2	C_3	C_4	C_5
1	2	1	2	2	2
2	3	2	3	3	3
3	0	0	0	0	2
4	2	1	1	1	1
5	1	0	0	0	0
6	1	1	1	1	2
7	4	4	3	3	3
8	4	4	4	4	4
9	0	0	0	0	0
10	3	2	2	3	3
11	4	3	3	4	3
12	2	2	1	3	1
13	2	4	2	0	0
14	3	3	3	2	0
15	1	3	4	1	2
16	1	2	2	2	2
17	0	3	2	2	1
18	3	1	1	1	1

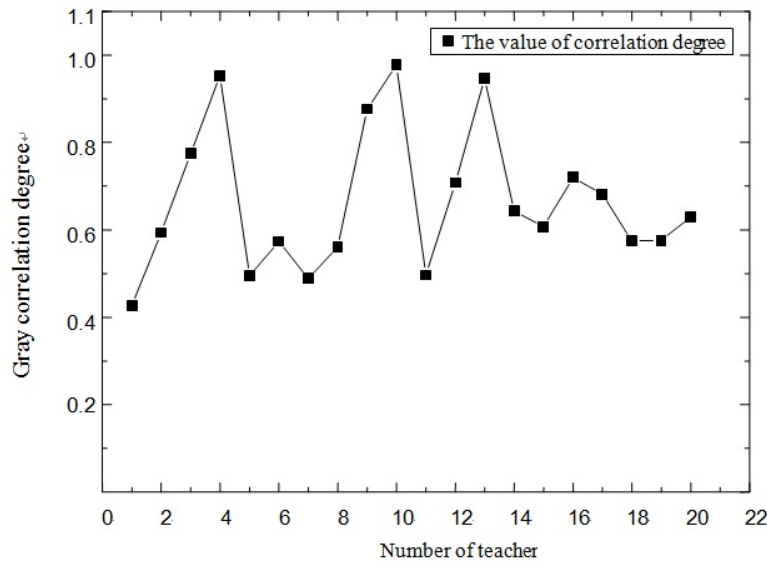


Figure 1: Gray related degree of teacher quality

$$sig(C_2, B; C) = 1 - \frac{14}{18} = \frac{2}{9} \quad sig(C_4, B; C) = \frac{2}{9} \tag{8}$$

The results indicate that professional level and moral conduct have the same importance in teacher quality evaluation. Since working performance reflects the quality of teacher in some degree, teacher quality evaluation removing professional level is necessary and significant. In the next section, we analyze the gray correlation degree between the indexes of teacher evaluation without professional level.

3 Gray correlation analysis

The statistical data in education research is limit, especially teacher quality research. As for the random fluctuation and people affected, the data is hard to present the distributed regularity [14]. In order to overcome the drawback of data, we adopt gray correlation analysis to explore the connection among the teacher quality data. The sequences of system:

$$\begin{aligned}
 X_0 &= (x_0(1), x_0(2), \dots, x_0(n)) \\
 X_1 &= (x_1(1), x_1(2), \dots, x_1(n)) \\
 &\dots\dots \\
 X_i &= (x_i(1), x_i(2), \dots, x_i(n)) \\
 &\dots\dots \\
 X_m &= (x_m(1), x_m(2), \dots, x_m(n))
 \end{aligned} \tag{9}$$

$$\gamma(x_0(k), x_i(k)) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \xi \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \xi \max_i \max_k |x_0(k) - x_i(k)|} \quad \gamma(X_0, X_i) = \frac{1}{n} \sum_{k=1}^n \gamma(x_0(k), x_i(k)) \tag{10}$$

where ξ is resolution, $\xi \in (0, 1)$. $\gamma(X_0, X_i)$ denotes gray related degree between X_0 and X_i .

The indicators C_1, C_3, C_4, C_5 are analyzed by using gray related analysis. Gray correlation degree are calculated through MATLAB and shown in Figure 1.

The sorted result of the gray related degrees of teacher quality: 10 > 4 > 13 > 9 > 3 > 16 > 12 > 17 > 14 > 20 > 15 > 2 > 19 > 18 > 6 > 8 > 11 > 5 > 7 > 1

Number 10 has the best comprehensive quality of teacher evaluation. Number 1 is the worst. The result is in accordance with actual data in Table 1. For example, the indexes value of teacher quality for number 10 are 28.2, 18.5, 18.8, 18.8, 9.5 respectively and number 4 teacher are 28.4, 18.6, 18.7, 18.5, 9.4 respectively. The sum of indexes value of number 10 is bigger than number 4. It indicates that the comprehensive quality of number 10 is better than number 4. This conclusion is in line with the result of gray related degree. In other words, rough set theory and gray related analysis are reliable and effective to evaluate the comprehensive quality of teacher.

4 Conclusion

The quality of teacher is the key of establishing the comprehensive universities. The level of it decides directly the height of the undergraduate's quality. Analyzing the mainly indicators of teacher quality is conducive to establish a scientific and reasonable evaluation system, improving the quality of college teacher actually. Using the rough set theory and gray correlation degree, this paper investigates the main factors that affect the quality of teacher in Chinese university and evaluates the comprehensive quality of teacher. The result indicates that (1) the evaluation of teacher quality plays a significant role in improving the quality of teaching staff. The evaluation mainly considers five indicators (responsibility, professional level, work performance, moral conduct, work willingness) in the evaluation system. (2) The indexes analysis of teacher evaluation based on rough set theory is beneficial to remove redundant indicators and filtrate important indicators. (3) We use gray related theory to calculate correlation degree of filtered indicators. The result indicate that the bigger correlation degree have better comprehensive quality. Rough set theory and gray related analysis provide new approaches to teachers' comprehensive quality evaluation.

The evaluation in this paper provides a method of judging the diathesis of teacher. The evaluation result contributes to the improvement of the comprehensive quality of teacher. Nevertheless, on account of the different feature of universities, the university would focus on the different evaluation indexes, standards and the weights of indicators.

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