



Research Article

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University English teaching quality evaluation system research based on multilevel fuzzy analysis

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ABSTRACT

Adopt multilevel fuzzy comprehensive evaluation method to carry out quantitative evaluation on university English teaching quality, and put forward evaluation grades. Through university undergraduate course talent training objectives, teachers development guiding thought, combining practical teaching situation, design a complete set of evaluation indicator system, and according to levels classification to make quantization on factors that reflect university English teaching quality, get a series of each level weight matrix. Through questionnaire survey on students, finally get fuzzy judgment matrix, calculate numeric fuzzy relation matrix, by multilevel compound operation, and finally define evaluation objects subordinate grades. The model relative integrally scientific evaluates university English teaching quality.

Key words: Multilevel fuzzy analysis, university English teaching quality, fuzzy judgment matrix

INTRODUCTION

At present, a sizable majority of students in university have less activity time and weak movement ability, with poor initiative conscientious training and overall physical quality, as well as current evaluation system cannot make scientific reasonable evaluation on students, causing these students generate a certain dislike emotion. Therefore, on the basis of sufficient recognition current evaluation system shortcomings and constraints, it is imperative to reform university English courses' evaluation system; Further reinforce evaluation development orientation function, highlight individual differences, attach importance to students efforts, affirm students' progress and stimulate students learning interests and positivist [1-3]; Further improve students physical quality comprehensive evaluation system, implement students integrated evaluation, perfect students self-assessment, mutual assessment as well as teachers evaluation methods [4-6]. So that university English teaching can really conform to university students' current situation [7].

Teaching quality evaluation is an effective measurement that school comprehensive improves teaching quality, adjusts teaching behavior, optimizes teachers' structures, propels teaching levels improvement, and makes teachers systematical and scientific management. In recently years, every school gives great impetus to education transformation, deepen authorized strength structural reform; ask more for classroom teaching quality [8-10]. This paper through establishing teacher's university English teaching quality evaluation system hierarchical figure, establishes fuzzy coherent judgment matrix and work out each indicator weight, by statistics analysis of different entirety (students, teachers, experts) questionnaire survey, respectively get fuzzy judgment matrix, work out different entirety evaluation scores, and get the classroom final results by weight calculating each evaluation scores.

MODEL HYPOTHESIS AND SYMBOL DEFINITION

Model hypothesis

● In university English teaching quality model evaluation process, teacher's self-assessment can honesty and trustworthy, put personality first, put forward objective evaluation on their own teaching advantages and

disadvantages, while teachers don't consider and care for each other in teachers' mutual evaluation.

- Students' evaluation is done before course testing, experts arrange staff to organize student seriously fill in evaluation form, students can initial realistic put forward their own evaluation according to their willing.
- All questionnaire survey can be returned, no loss and tampering.
- Expert evaluation is implemented by expert evaluation group, the expert evaluation group according to daily lectures, hold students forum, test students homework, student's test papers, teachers' teaching plan as well as teaching report checking and other status to carry out evaluation.
- If following situation happened, then it direct defined as unqualified.
- A, Teaching accidents appear for many times.
- B, half students that participate in evaluation evaluate teaching effects as unqualified, it directly judged as unqualified.

Symbol system appointment and relative formula

According to above level model, define following symbol system as well as relative formula that related to algorithm:

(1) In first level evaluation indicator, let teacher self-assessment, teachers mutual assessment, experts evaluation, students assessment respectively as A_1, A_2, A_3, A_4 get first grade indicator factor set as: $A = \{A_1, A_2, A_3, A_4\}$.

(2) In second level evaluation indicator, let teaching objective, teaching content, teaching method, teaching quality, teaching effect, answer questions respectively to be $B_1, B_2, B_3, B_4, B_5, B_6$, get second level indicator factor set as $B = \{B_1, B_2, B_3, B_4, B_5, B_6\}$.

(3) In the third evaluation indicator, let subordinate second level indicator $B_i (i = 1, 2, 3, 4, 5, 6)$ third indicator to be combination $C_{i1}, C_{i2}, C_{i3}, C_{i4}, C_{i5}, B_{i6}$, record as $C_i \{C_{i1}, C_{i2}, C_{i3}, C_{i4}, C_{i5}, B_{i6}\}$, it is obvious that second indicator $B_i (i = 1, 2, 3, 4, 5, 6)$ affiliated third indicator set C_i included factors some have not arrived at 6 items, here we make handling as following: For gap in gap set C_i , it can directly omit, as C_1 records as C_{11}, C_{12} , corresponding {teaching accuracy, conform to practice}.

(4) Define evaluation levels as four levels: excellent (90-100)、good(80-90)、qualified(60-80)、unqualified(0—60). Respectively record as V_1, V_2, V_3, V_4 , we establish evaluation set $V \{V_1, V_2, V_3, V_4\}$.

(5) Define evaluation indicator system weights. In model, weight is of great importance that directly influences on comprehensive evaluation results; here weight solution is defined by constructing into comparison matrix. Assume there is one set $A = \{A_1, A_2, A_3, A_4, A_5, A_6\}$ (here casually make an example, different from first level indicator factor set) as an example, we establish fuzzy coherent judgment matrix as following:

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix}$$

Among them, a_{ij} represents factor A_i and factor A_j have fuzzy relations " A_i more important membership than A_j ", refer to Table 1.

Table 1: Membership parameters table

Scale a_{ij}	Definition
1	A_i and A_j have the same influence
3	A_i has slight stronger influence than A_j
5	A_i and A_j have strong influences
7	A_i and A_j influences are obviously strong
9	A_i and A_j influences are absolutely strong
2, 4, 6, 8	A_i and A_j influences ratio is between above two adjacent ranks
1, 1/2, ..., 1/9	A_i and A_j influences ratio is above reciprocal

According to relative theory, it can solve maximum feature root corresponding feature vector W and the set weight vector, Matlab software is adopted in this paper calculation to make solution [11]. Meanwhile it brings into Saaty analytic hierarchy process inconsistency definition and inconsistent matrix weight vector solution method. Saaty defines $C_i = (d - n)/(n - 1)$ as consistency indicator, from which d represents A maximum feature root, n represents A degree. And bring into random consistency indicator R_i , its value as following Table 2.

Table 2: Random consistency indicator R_i values

n	1	2	3	4	5	6	7	8	9	10	11
R_i	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

For $n \geq 3$ paired comparison matrix A, call its consistency indicator CI and same degree (refers n is the same) random consistency indicator R_i ratio as consistency ratio CR, when $CR = CI/RI < 0.1$, it is thought A inconsistency degree is within tolerance, can regard its feature vector as weight vector. According to above explanation, we can get first level factor indicator vector set weight vector as $W_A = [W_{A1}, W_{A2}, W_{A3}, W_{A4}]$; second factor indicator set weight vector as $W_B = [W_{B1}, W_{B2}, W_{B3}, W_{B4}, W_{B5}, W_{B6}]$, similarly we can get the third factor each indicator set weight vector as $W_{B1} = [W_{11}, W_{12}]$, $W_{B2} = [W_{21}, W_{22}, W_{23}, W_{24}]$, $W_{B3} = [W_{31}, W_{32}, W_{33}, W_{34}, W_{35}]$, $W_{B4} = [W_{41}, W_{42}, W_{43}, W_{44}]$, $W_{B5} = [W_{51}, W_{52}, W_{53}, W_{54}, W_{55}]$, $W_{B6} = [W_{61}, W_{62}]$.

(6) Define the fourth level comprehensive judgment matrix R_{jk} ($j=1,2,3,4$, respective on behalf of deriving from teacher self-assessment, teachers mutual assessment, experts evaluation, students evaluation questionnaire constructed comprehensive judgment matrix). According original information that we collect from questionnaire survey, through Excel software handling, it gets 6 third indicators of classroom evaluation each factor excellent ratio, good ratio, qualified ratio and unqualified ratio. As following:

$$R_k (k = 1, 2, 3, 4, 5, 6) = \begin{pmatrix} r_{k11} & r_{k12} & r_{k13} & r_{k14} \\ r_{k21} & r_{k22} & r_{k23} & r_{k24} \\ r_{k31} & r_{k32} & r_{k33} & r_{k34} \\ r_{k41} & r_{k42} & r_{k43} & r_{k44} \end{pmatrix}$$

Among them, $r_{k11}, r_{k12}, r_{k13}, r_{k14}$ respectively represent second level indicator factor B_k affiliated third level factor C_{k1} excellent ratio, good ratio, qualified ratio and unqualified ratio.

(7) Define the third level comprehensive judgment matrix P . The third level each factor comprehensive judgment matrix $P_{ji} = R_{ji} * W_{bi} (i = 1, 2, 3, 4, 5, 6)$. Finally it can get $P_j = [P_{j1}, P_{j2}, P_{j3}, P_{j4}, P_{j5}, P_{j6}]^T (j = 1, 2, 3, 4)$ respectively on behalf of deriving from teacher self-assessment, teachers mutual assessment, experts evaluation, students evaluation the fourth comprehensive judgment matrix achieved the third level comprehensive judgment matrix).

(8) Our second level comprehensive judgment matrix S_1, S_2, S_3, S_4 . For second level teacher self-assessment, teachers' mutual assessment, experts' evaluation, students' evaluation, we all can calculate its comprehensive judgment matrix S_1, S_2, S_3, S_4 . Its computational method is:

$$S_j = W_b * P_j = [w_1, w_2, w_3, w_4, w_5, w_6] * [P_{j1}, P_{j2}, P_{j3}, P_{j4}, P_{j5}, P_{j6}]^T$$

(9) Evaluation grades and scores are corresponding as Table 3. Scores vector is $Q = [95, 85, 70, 53]^T$.

Table 3: Evaluation grades and corresponding scores

Grades	Excellent	Good	Qualified	Unqualified
Score level	90—100	80-90	60-80	45-60
Representative scores	95	85	70	53

(10) Calculate the second level scores respectively from teacher self-assessment, teachers' mutual assessment, experts' evaluation, students' evaluation Q_1, Q_2, Q_3, Q_4 . $Q_i = S_i * Q (i = 1, 2, 3, 4)$.

$$\text{Final results } \text{Result} = [Q_1, Q_2, Q_3, Q_4] * W_A = [Q_1, Q_2, Q_3, Q_4] * [W_{A1}, W_{A2}, W_{A3}, W_{A4}]$$

ALGORITHM ANALYSIS AND SOLUTION

Handle with questionnaire survey, get students evaluation scores S_4 . From collecting questionnaire survey for students, carry out grades evaluation on university English teaching level model the fourth level 22 indicators, make use of EXCEL to implement data statistics, analysis of evaluation results. It can get the third level affiliated 5 fuzzy judgment matrix.

Accordingly it can get following teaching objectives fuzzy judgment matrix R_{41} (4 represents students-based questionnaire survey data):

$$R_{41} = \begin{pmatrix} 0.18 & 0.37 & 0.33 & 0.12 \\ 0.21 & 0.44 & 0.21 & 0.14 \end{pmatrix}$$

Similarly, it can get teaching content fuzzy judgment matrix R_{42} , teaching method fuzzy judgment matrix R_{43} , teaching quality fuzzy judgment matrix R_{44} , teaching effect fuzzy judgment matrix R_{45} , answer questions fuzzy judgment matrix R_{46} .

$$R_{42} = \begin{pmatrix} 0.30 & 0.55 & 0.15 & 0.00 \\ 0.23 & 0.43 & 0.34 & 0.00 \\ 0.19 & 0.40 & 0.33 & 0.08 \\ 0.21 & 0.33 & 0.46 & 0.00 \end{pmatrix} \quad R_{43} = \begin{pmatrix} 0.23 & 0.4 & 0.32 & 0.01 \\ 0.25 & 0.32 & 0.39 & 0.04 \\ 0.44 & 0.34 & 0.22 & 0.00 \\ 0.23 & 0.46 & 0.29 & 0.02 \\ 0.20 & 0.41 & 0.28 & 0.11 \end{pmatrix}$$

$$R_{44} = \begin{pmatrix} 0.33 & 0.43 & 0.24 & 0.00 \\ 0.35 & 0.41 & 0.30 & 0.00 \\ 0.19 & 0.41 & 0.30 & 0.10 \\ 0.34 & 0.33 & 0.28 & 0.05 \end{pmatrix} \quad R_{45} = \begin{pmatrix} 0.23 & 0.45 & 0.22 & 0.10 \\ 0.32 & 0.33 & 0.45 & 0.00 \\ 0.34 & 0.43 & 0.23 & 0.00 \\ 0.36 & 0.47 & 0.17 & 0.00 \\ 0.41 & 0.36 & 0.23 & 0.00 \end{pmatrix}$$

$$R_{46} = \begin{pmatrix} 0.80 & 0.20 & 0.00 & 0.00 \\ 0.76 & 0.24 & 0.00 & 0.00 \end{pmatrix}$$

Determine the second level indicator and third level indicator weight vectors. Take teaching objective affiliated two factors "scientific accurate, conform to practice" and "moral education infiltration, natural and appropriate" as

$$B_1 = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$$

examples, firstly establish its paired comparison matrix

According to above provided formula, it can calculate weight vector $W_{B1} = [0.5, 0.5]$. According to university English teaching features, put forward corresponding paired comparison matrix, and solve its corresponding weight vector as following:

$$W_{B2} = [0.25, 0.25, 0.25, 0.25]$$

$$W_{B3} = [0.3, 0.25, 0.25, 0.05, 0.1]$$

$$W_{B4} = [0.2, 0.3, 0.3, 0.2]$$

$$W_{B5} = [0.2, 0.2, 0.1, 0.2, 0.2, 0.1]$$

$$W_{B6} = [0.4, 0.6]$$

All paired vector matrixes meet consistency judgment criterion that is $CR < 0.1$.

For second level indicator, its paired comparison matrix as judgment matrix is:

$$\begin{pmatrix} 1.0000 & 0.5000 & 0.3333 & 0.5000 & 0.2500 & 2.0000 \\ 2.0000 & 1.0000 & 2.0000 & 2.0000 & 3.0000 & 3.0000 \\ 3.0000 & 0.5000 & 1.0000 & 2.0000 & 0.3333 & 2.0000 \\ 2.0000 & 0.5000 & 0.5000 & 1.0000 & 0.3333 & 2.0000 \\ 4.0000 & 0.3333 & 3.0000 & 3.0000 & 1.0000 & 4.0000 \\ 0.5000 & 0.3333 & 0.5000 & 0.5000 & 0.2500 & 1.0000 \end{pmatrix}$$

It gets by calculation as $CR = 0.0783$, meet consistency requests. Meanwhile weight vector is:

$$W_B = (0.0837, 0.3121, 0.1551, 0.1128, 0.2728, 0.0635)$$

It gets by calculation as $CR = 0.0878$, $W_A = (0.1215, 0.1127, 0.2928, 0.4730)$.

(3) Calculate second level indicator comprehensive judgment matrix P according to above provided formula $P_{ji} = R_{ji} * W_{bi} (i = 1, 2, 3, 4, 5, 6)$, successively work out:

$$P_{41} = [0.1950 \quad 0.4050 \quad 0.2700 \quad 0.1300] \quad P_{42} = [0.2325 \quad 0.4275 \quad 0.3200 \quad 0.0200]$$

$$P_{43} = [0.2830 \quad 0.3695 \quad 0.3050 \quad 0.0305] \quad P_{44} = [0.2960 \quad 0.3980 \quad 0.2660 \quad 0.0400]$$

$$P_{45} = [0.3205 \quad 0.4180 \quad 0.2565 \quad 0.0250] \quad P_{46} = [0.7760 \quad 0.2240 \quad 0 \quad 0]$$

Finally get second level indicator comprehensive judgment matrix:

$$P_4 = \begin{pmatrix} 0.195 & 0.405 & 0.270 & 0.130 \\ 0.233 & 0.428 & 0.320 & 0.020 \\ 0.283 & 0.370 & 0.305 & 0.305 \\ 0.296 & 0.398 & 0.266 & 0.04 \\ 0.321 & 0.418 & 0.257 & 0.025 \\ 0.776 & 0.224 & 0 & 0 \end{pmatrix}$$

(4) Get first level factor students evaluation comprehensive judgment matrix $S_4 = W_B * P_4$, calculate by Matlab as:

$$S_4 = [0.3029 \quad 0.3978 \quad 0.2698 \quad 0.0332]$$

(5) Calculate students questionnaire data-based evaluation score Q_4 . $Q_4 = S_4 * Q$ That is:

$$Q_4 = [0.3029 \quad 0.3978 \quad 0.2698 \quad 0.0332] * [95-85-70-53]^T = 83.2341$$

(6) Similarly it can work out scores from teacher's self-assessment, teacher's mutual assessment, expert's evaluation S_1, S_2, S_3 .

CONCLUSION

Through multilevel fuzzy analysis method, established university English teaching quality evaluation system structural figure, made consistency test at comparison matrix, proposed each indicator weight that avoided artificial subjectivity decision. Through received questionnaire survey original data statistical analyzing and standardize handling, it given university English teaching quality evaluation final scores. The model could scientific and objectively evaluate university English teaching quality and reflect our school teaching transformation spirit and "Three basis and Four Abilities" talents cultivating programs requests.

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