A Novel Fuzzy Evaluation Method on Teaching Quality of College English based on Preference Selection Index

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Abstract. The evaluation of teaching quality is an important part of the quality management of teaching in colleges and universities. Many evaluation systems exist shortcomings, which are not suitable for the evaluation of English class. Because English subject has its own characteristics, in which the evaluation subject taken on students is more suitable than on teachers. This paper will propose a college English evaluation index system on the basis of students as the evaluation subject. Since the evaluation indicators are mainly qualitative indicators, which makes the evaluation value fuzzy, this paper proposes a new evaluation method of college English classroom teaching evaluation based on linguistic terms, triangular fuzzy numbers and preference selection index method. Finally, an algorithm case is analyzed to illustrate the effectiveness and feasibility of the proposed method.

1. Introduction
The evaluation of teaching quality is a value judgment made by using the theory and technology of education evaluation on whether the teaching process and its results meet certain quality requirements [1]. Many scholars have done a lot of in-depth and perfect research on theory, evaluation content, evaluation subject, evaluation content, evaluation method and even influencing factors [2]. With the deepening of College English teaching reform, the evaluation of College English teachers can not only be limited to the traditional classroom teaching. Second, the connotation of some evaluation indicators is beyond the students' understanding ability. At present, the main body of University rating is students. The rating table is also designed for students. The evaluation index should be within the scope of students' understanding ability. Looking at the existing English teaching evaluation system, some indicators are obviously beyond the scope of students' understanding [3]. For example, in the index of "the content is rich, which can reflect the new achievements and new trends of the subject", obviously, students don't understand the new achievements and new trends, so they can't make an objective and fair judgment. Reference [4] is aware of these problems and try to use fuzzy comprehensive evaluation method to combine qualitative evaluation and quantitative evaluation, which provides a new perspective for the study of College English teaching quality evaluation.

However, most of these studies focus on other subjects, some of which only make a fuzzy evaluation of oral English, grammar, or multimedia. This paper attempts to establish a practical teaching quality evaluation system based on students. First, the evaluation values of indicators are firstly transformed into triangular fuzzy numbers (TFNs), and then we put forward a new evaluation
method to evaluate English teaching quality based on Preference Selection Index method, first proposed by Maniya and Bhatt in [5], which is a well-known multi-attribute decision making method.

2. Evaluation Model of College English Teaching

In the great wave of college English teaching reform, extra-curricular counselling has gradually become the new normal of college English teaching. It is not only a supplement to classroom teaching but also a supplement[6]. As a first-level indicator, it highlights its function and function in College English teaching. The specific evaluation indicators are described in Table 1.

| Indicators                | Context of each indicator                                                                 |
|--------------------------|--------------------------------------------------------------------------------------------|
| Teaching attitude \(o_1\) | Enthusiastic and willing to communicate with students; attends and leaves classes on time and makes effective use of class time. |
| Teaching content \(o_2\)  | Appropriate integration of English cultural background knowledge; appropriate guidance of learning strategies and methods; content enrichment, highlighting key points and difficulties, etc. |
| Teaching methods \(o_3\)  | Proficient in explanation and in depth; proficient in using multimedia and other teaching equipment; classroom teaching forms are various; inspires students' thinking and pays attention to the development of students' critical thinking; good interaction and active classroom atmosphere; takes into account the differences in students' English level. |
| Teaching language \(o_4\) | English pronunciation standard; uses a lot of English and Chinese properly; fluent, clear and simple. |
| Extracurricular tutoring \(o_5\) | Homework is properly arranged, which can consolidate the effect of classroom learning; after class (online) tutoring is detailed and timely; actively guide and participate in all extracurricular English activities. |
| Teaching effect \(o_6\)   | Gained a lot in classroom learning and improved its English performance; built up the confidence to learn English well; improved its oral English. |

The language evaluation set can be used to evaluate the quality of English teaching. Now, the set of evaluation indicators are divided into seven grades and the relationship of linguistic terms with TFNs is[4]: When Linguistic terms set is \{ Very Poor (VP), Poor (P), Medium Poor (MP), Fair (F), Medium Good (MG), Good (G), Very Good (VG)\}, the corresponding TFNs set is \{(0,0,1), (0,1,3), (1,3,5), (3,5,7), (5,7,9), (6,9,10), (7,9,10)\}. The definition of TFN can be found in [7], and the operational law of two any TFNs \(A=(a_1,a_2,a_3)\) and \(B=(b_1,b_2,b_3)\) is:

\[
A + B = (a_1 + b_1,a_2 + b_2,a_3 + b_3) \quad \text{and} \quad kA = (ka_1,ka_2,ka_3), k \in R .
\]

Considering the problem of classroom teaching evaluation of English Majors in Colleges and universities, a set of teachers \(X = \{x_1, x_2, \ldots, x_n\}\) is to be evaluated, and the set of evaluation indicators is \(O = \{o_1, o_2, \ldots, o_6\}\). The importance of the \(j\)th indicators is \(w_j\). A set of evaluation experts is \(D = \{D_1,D_2,\ldots,D_s\}\). The evaluation value is a linguistic term \(\tilde{s}_{ij}^k\), provided by \(D_j\), is the rating of \(x_i\) on \(o_j\), so the evaluation decision matrix is obtained with the form \(\tilde{S}^k = (\tilde{s}_{ij}^k)_{n \times s}\), which requires the evaluation of teachers’ teaching quality according to \(\tilde{S}^k, k = 1,2,\ldots, s\). Now, we give the evaluation model, and the calculation steps are given as follows:

**Step1.** Collect \(\tilde{D}^k = (\tilde{a}_{ij}^k)_{n \times s}\) into a crisp decision making matrix \(\tilde{R} = (\tilde{r}_{ij})_{n \times s} = ((r_{ij}^m, r_{ij}^n))_{n \times s}\) as in [8], where \(\tilde{r}_{ij} = (\tilde{a}_{ij}^k + \tilde{a}_{ij}^k + \cdots + \tilde{a}_{ij}^k)/s\).

**Step2.** Transform \(\tilde{R} = (\tilde{r}_{ij})_{n \times s}\) into decision matrix \(X = (x_{ij})_{n \times s}\), where \(x_{ij} = (r_{ij}^m + r_{ij}^n + r_{ij}^n)/3\).

**Step 3.** Determine weights of the index using entropy weight method as in [9].
Step 4. Compute the preference variation value ($PV_j$) and overall preference value ($\Psi_j$) as:

$$PV_j = \sum_{i=1}^{m} (w_j r_j - w_j \bar{r}_j)^2, \quad \Psi_j = \Phi_j / \sum_{j=1}^{n} \Phi_j,$$

where $r_j = \sum_{i=1}^{m} r_{ij} / m$ and $\Phi_j = 1 - PV_j$.

Step 5. Calculate the preference selection index ($I_i$): $I_i = \sum_{j=1}^{n} r_{ij} \times \Psi_j$ and give the evaluation result according to the rule: The larger the value of $I_i$ with the better teaching quality of the teacher $x_i$.

3. Numerical case study

A foreign language college plans to evaluate the teaching quality of three English teachers $x_1, x_2, x_3$ in the college. The evaluation indicators are as in the second section. The college employs 10 peer experts to form an expert group. The expert group evaluates the four teachers, and the evaluation values are shown in Table 2.

| Indicators | Teachers | Linguistic terms and corresponding expert numbers |
|------------|----------|--------------------------------------------------|
|            | $x_1$    | P F G VG E                                       |
| $o_1$      | $x_2$    | 0 1 3 4 2                                       |
|            | $x_3$    | 1 3 3 2 1                                       |
|            | $x_1$    | 0 1 4 2 3                                       |
| $o_2$      | $x_2$    | 0 2 4 1 3                                       |
|            | $x_3$    | 0 2 2 5 1                                       |
|            | $x_1$    | 0 2 2 4 2                                       |
| $o_3$      | $x_2$    | 1 1 4 2 2                                       |
|            | $x_3$    | 0 1 3 3 3                                       |
|            | $x_1$    | 0 3 3 3 1                                       |
| $o_4$      | $x_2$    | 0 1 3 4 2                                       |
|            | $x_3$    | 0 2 5 2 1                                       |
|            | $x_1$    | 0 1 2 3 4                                       |
| $o_5$      | $x_3$    | 1 2 4 2 1                                       |
|            | $x_1$    | 0 3 4 2 1                                       |
| $o_6$      | $x_2$    | 0 1 2 5 2                                       |
|            | $x_3$    | 0 2 4 3 1                                       |

The following uses the methods proposed in this paper to evaluate the classroom teaching quality of these four teachers. The specific steps are as follows:

Step 1. Gather expert evaluation information into a TFN decision matrix $\tilde{A} = (\tilde{a}_{ij})_{4 \times 6}$, where

$$\tilde{A} = \left( \begin{array}{cccccc}
42.5,67.5,87.5 & 42.5,67.5,85 & 45.00,70.00,85.00 & 30.55,77.5 & 50.75,90 & 27.5,52.5,75 \\
40.65,85 & 37.5,62.5,80 & 35,57.5,77.5 & 42.5,67.5,87.5 & 27.5,50,72.5 & 45,70.90 \\
25,47.5,70 & 37.5,62.5,85 & 45,70,87.5 & 30,55,77.5 & 50,75,90 & 32.5,57.5,80 \\
\end{array} \right)$$

Step 2. The attribute weights obtained by entropy weight method are:

$w_1 = 0.2136, w_2 = 0.0135, w_3 = 0.1233, w_4 = 0.1146, w_5 = 0.3369, w_6 = 0.1982$. 


**Step 3.** Calculate the preference variation value \((PV_j)\), deviation \((\Phi_j)\), and overall preference variation value \((\Psi_j)\), and illustrate them in Table 3.

|      |      |      |      |      |      |
|------|------|------|------|------|------|
| \(PV_j\) | 18.0440 | 0.0073 | 3.9010 | 2.9322 | 81.3428 | 15.8633 |
| \(\Phi_j\) | -17.0440 | 0.9927 | -2.9010 | -1.9322 | -80.3428 | -14.8633 |
| \(\Psi_j\) | 0.1468 | -0.0086 | 0.0250 | 0.0166 | 0.6921 | 0.1280 |

**Step 4.** The preference selection indexes are obtained as follows:

\[
I_1 = 20.3864, I_2 = 15.6713, I_3 = 19.9414
\]

Then the results of English teaching quality evaluation of these four teachers are \(x_1 > x_3 > x_2\).

4. **Conclusions**

In view of the problems in classroom teaching quality evaluation of College English teachers, this paper puts forward an evaluation index system of English teaching quality. This index system takes the students as the main body of evaluation, and its content is comprehensive. The language is concise and easy to understand, which can better monitor and guide college English teaching. On this basis, this paper proposes a triangular fuzzy number based assessment method of English classroom teaching quality. Compared with the conventional weighted average method, the fuzzy evaluation method proposed in this paper effectively reduces the interference brought by the fuzziness of indicators and makes the evaluation results have higher reliability and validity.

**Acknowledgments**

The author thanks for the support of the Science and Technology Research Project of Jiangxi Educational Committee (No. GJJ170496) and School Level Teaching Reform of JUST (No. XJG-2018-35).

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