

## **Evaluation of College English Teaching Quality Based on Grey Clustering Analysis**

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**Abstract**—Currently, there are two main problems with the evaluation of college English teaching quality: the lack of a complete evaluation system, and the limited quantification of evaluation indices. To solve the problems, this paper sums up the evaluation contents of college English teaching quality, and identifies the factors affecting the teaching quality of college English. On this basis, an improved evaluation system was established for the assessment of college English teaching quality, which is theoretically innovative. Next, grey clustering analysis and entropy weight method were combined into a robust evaluation model for college English teaching quality. This research provides a new and applicable solution to quantification of college English teaching quality.

**Keywords**—Teaching quality, English teaching, colleges, grey clustering analysis, evaluation model

### **1 Introduction**

As an international common language, English is of great significance in the process of global integration. It not only plays the role of international communication, but also greatly promotes the global politics, economy, culture, trade, education, and other fields [1-3]. English has gradually become an important part of higher education, and the level of English has been an important quality of senior talents. In modern higher education, one of the important goals is to fully improve the comprehensive English ability of college students [4-5]. For this reason, English teaching in colleges has gradually attracted more attention. It has been a hot issue in higher education research on how to carry out an effective and reliable evaluation and analysis of the English teaching quality in colleges, and to improve the quality of English teaching. Also, the evaluation of teaching quality in some related disciplines provides reference value for the improvement of English teaching quality. Rus studied and analyzed innovative methods in English teaching of engineering majors [6]. Zrníková discussed the needs analysis and quality evaluation in medical English teaching [7]. Wang and Song gave a fuzzy comprehensive evaluation of English teaching quality based on bat algorithm, and combined with examples to verify and analyze the algorithm [8]. Liu explored the construction of the higher vocational English course evaluation system under the modern vocational education system [9]. Gu presented a teaching quality evaluation model based on gray

correlation analysis and neural network [10]. Wang et al. analyzed how to build an application-oriented undergraduate college teaching quality evaluation system in the context of industry-education integration [11], and the related model and evaluation system provide a good reference value for the evaluation of English teaching quality. Guan et al. discussed the advantages of computer-assisted English teaching and the way of improving the quality of English teaching [12]. Starkey analyzed and discussed the key factors that affect the attitude and cognition of second language English teaching in nursing major [13].

However, the evaluation of English teaching quality in colleges involves many factors, and different researchers often have different perspectives on the related analysis, making the research results have a specific scope of adaptation. And following the continuous development of modern society, the training objectives, and requirements of modern higher education for the English professionals are constantly changing, and the existing evaluation systems and strategies for college English teaching quality also have certain limitations. To this end, based on the existing research results, this paper analyzes the current status of English teaching in colleges, and discuss an improved method for evaluating the quality of college English teaching using the gray system theory [14-15] and the entropy weight method [16-19].

The remainder of this paper is organized as follows: Section 2 mainly analyzes the related factors affecting the teaching quality of college English; Section 3 sets up an improved evaluation system of college English teaching quality; Section 4 establishes a grey clustering evaluation model of English teaching quality in colleges; Section 5 puts forward the research conclusions.

## **2 Factors Affecting the Teaching Quality of College English**

### **2.1 Unbalanced allocation of faculty**

Compared with the science and engineering majors in colleges, the faculty of English majors is generally weak. This is due to the limited investment in teaching and research, negatively influencing the construction of teaching and research offices, the development of innovation bases, and the introduction of senior talents for the development of English majors, which will bring certain pressure and restrictions to the improvement of the English teaching ability. Especially in the training of English professional talents, the lack of senior title teachers, the insufficient introduction of highly educated talents, and the management's lack of attention to professional talent training all may lead to the lack of young and middle-aged English teacher.

### **2.2 Insufficient teaching reform and innovation**

The survey analysis found that the current teaching of English majors in colleges is basically carried out in accordance with the traditional teaching model, mainly focusing on students' theoretical knowledge learning, while ignoring their practical language learning. Especially with the rapid development of global integration, international

communication and cooperation increasingly require English professionals with strong comprehensive ability. For this reason, it's urgently needed to combine the development demands of modern society, keep pace with the development of the times, and cultivate English professionals with strong adaptation ability. This requires colleges to integrate the actual situation of English teaching, and present innovative English teaching models and teaching concepts through comprehensive teaching reforms in teaching methods, means, and techniques, etc., thereby meeting the needs of the times for modern English teaching of higher education.

### **2.3 Insufficient attention to quality-oriented education and emphasizing on exam-oriented education**

Most employers and institutions pay more attention to the English scores of major students, especially some English proficiency certificates, which leads to the phenomenon of achievement-based English teaching in colleges. Such teaching only emphasizes on the test-taking skills of English knowledge in all aspects, but ignoring the essential issue for English as a tool of language communication. Therefore, at present, the test-oriented education model is mainly implemented in college English teaching, and there are still certain limitations in quality-oriented education. Although college students may obtain good English scores in the exams, their comprehensive application of English language still needs to be further improved.

### **2.4 Lack of teaching management, and disconnection between classroom teaching and practice**

English teaching in colleges is composed of multiple components such as English listening teaching, oral English teaching, English reading teaching, English writing teaching, English translation teaching, etc. These English teaching components and links often include different teaching modules such as classroom teaching and practical teaching etc. From the perspective of language learning, these English teaching components, and modules are an organic whole and have a mutually supportive effect. It requires teaching administrator and English teachers to reasonably plan the teaching content and set up the implementation process of English teaching, emphasizing on both local English teaching links and the integrity of English teaching. Judging from the current situation of English teaching in colleges, English teaching mainly focuses on the teaching of courses and the teaching of English theoretical knowledge, but the integration with practical knowledge still has limitations.

### **2.5 Inadequate application of intelligent technology**

With the rapid development of modern science and technology, modern intelligent education technology has been widely used in higher education, and multimedia classrooms and digital teaching centers have provided good support. Especially in recent years, the application of artificial intelligence technology in higher education, such as network information technology, virtual reality technology, computer vision

technology, speech recognition technology, machine learning technology, knowledge processing technology, etc., has rapidly promoted the teaching level of higher education. However, these technologies are mostly applied in the teaching or scientific research of science and engineering courses, but not English teaching in college. Therefore, it is of great research significance on how to effectively use these intelligent technologies for teaching of English knowledge and improvement of college English teaching efficiency and quality.

### **2.6 The insufficient capacity of curriculum system construction**

The curriculum system of English teaching in colleges should be constructed in different aspects, including systematic quality courses, sustainable development of course materials, and curriculum reform system that meets the characteristics of the times etc. That is, during the teaching links of English listening teaching, oral English teaching, English reading teaching, English writing teaching, English translation teaching, it requires the colleges to not only provide the support of the related English teaching curriculum system, but also reasonably plan English teaching tasks, teaching outlines, teaching plans, teaching content and teaching development planning framework according to the dynamics and scientifically of social development.

## **3 Improved Evaluation System of College English Teaching Quality**

### **3.1 Key problems in the selection of evaluation indicators of college English teaching quality**

From the perspective of the English teaching quality evaluation process in colleges, it involves the processing and analysis of multiple types and forms of evaluation indicators. The evaluation process is essentially a very complicated systematic engineering decision analysis. Therefore, it's very important to select the evaluation indicators of college English teaching quality effectively and reasonably for achieving the reliable and accurate evaluation results. To this end, the author believes that the selection of evaluation indicators for college English teaching quality needs to follow the basic guiding principles of scientificity, systematicness, objectivity, typicality, independence, and operability. The principle of scientificity requires the evaluation indicators of college English teaching quality to have a clear scientific meaning, which can characterize the essential problems for the assessment of English teaching quality. The principle of systematicness means that the evaluation indicators are systematic, and there must be a strong logic between the indicators. The objectivity principle is to require selecting the college English teaching quality evaluation indicators based on the objective facts of the evaluation objects, rather than on subjective imagination. The principle of typicality is to require that the evaluation indicators are representative. Due to various influencing factors involved in the evaluation of college English teaching quality, it is unrealistic to fully consider all the evaluation factors, and difficult to operate. Thus, it has good

engineering application value to select typical evaluation indicators for evaluation analysis. The principle of independence means to avoid repeated evaluation and redundant information between evaluation indicators as much as possible. The operability principle is to require that the evaluation indicators are conducive to the quantitative analysis of the evaluation information, for obtaining more accurate and reliable evaluation results.

### 3.2 Establishing an evaluation system of college English teaching quality

According to the above analysis, the author believes that a comprehensive analysis for assessing college English teaching quality should be carried out in the four aspects: the basic guarantee conditions for college English teaching, the implementation process of college English teaching, the implementation results of college English teaching, and the ability improvement and performance of college English majors.

#### 1. Basic guarantee conditions for the implementation of college English teaching $A_1$

The basic guarantee conditions for the implementation of college English teaching can be subdivided into four parts: college English teaching management ability  $a_{11}$ , English curriculum teaching planning ability  $a_{12}$ , English curriculum system construction ability  $a_{13}$ , and English teacher professional quality and ability  $a_{14}$ . The college English teaching management ability mainly refers to the functional construction of English teaching and research offices in colleges, the configuration of software and hardware facilities for English major teaching according to the needs of English major curriculum teaching, and the investment of English major teaching and research funding in line with the development of English major teaching; meanwhile, it is also necessary to investigate the rationality of the management rules and regulations of English major teachers and students. The ability of English curriculum teaching planning needs to be comprehensively considered in different aspects such as the rationality of English curriculum planning in college English teaching planning process, the perfection of the English syllabus planning, the formulation of English teaching task, the rationality of English curriculum progress, and the formulation and implementation of English teaching lesson planning. The English curriculum system construction ability is evaluated to examine the sustainable development of English teaching from many aspects, including the construction of English teaching teams, the number of teaching achievements, whether there are famous teachers at or above the provincial level, English teaching reform projects at or above the provincial level, the awards, the publication of high-level English teaching papers, the construction of excellent textbooks for English majors, the construction of English major curriculum systems, and the construction of basic curriculum systems, etc. The professional quality and ability of English teachers is a comprehensive survey of the number and ratio of college English professional teachers at senior professional titles, the number and ratio of English professional teachers with senior professional qualifications; the increase in the number and ratio is conducive to the improvement of English teaching quality; in addition, it is necessary to examine the teaching experience, professional comprehensive ability and teaching

innovation ability of English professional teachers in colleges, which is important for improving the teaching level and teaching quality of English teachers.

## 2. Implementation process of college English teaching $A_2$

The implementation process of college English teaching mainly focuses on the operational content and implementation links in the process of college English teaching (including theoretical classroom teaching, and practical teaching, etc.), which can be subdivided into English teaching content  $a_{21}$ , English teaching methods  $a_{22}$ , English teaching means  $a_{23}$ , English teaching model  $a_{24}$ , English teaching attitude  $a_{25}$  and English teaching assessment  $a_{26}$  etc. The English teaching content of colleges must first reflect the characteristics of English majors, and focus on the combination of English theory and curriculum practice. It needs to have good logic, systemic and cutting-edge, and keeps pace with the times on the premise of ensuring a rich teaching content. English teaching methods should show a certain degree of flexibility and rationality, emphasizing on the scientificity of teaching methods and the ability to design and teach students according to their aptitude, but not imparting English knowledge mechanically. English teaching means is to reflect the diversified and intelligent characteristics, and especially in the context of the rapid development of modern intelligent technology, the application of intelligent teaching methods in the field of higher education engineering has become more and more in-depth, which is of great significance for improving the quality of English teaching. The English teaching model should focus on the integration of the theory and practice of English teaching; it's no longer be limited to the traditional test-oriented education model, but to make a qualitative change to the quality education model. English teaching attitude shows whether English teachers can take a positive and correct teaching attitude in the teaching process, thus reflecting the teaching enthusiasm and concentration. English teaching assessment is an effective supervision and feedback on the quality of English teaching, so it is necessary to set up the English teaching assessment link and content in colleges.

## 3. Implementation results of college English teaching $A_3$

The implementation result of college English teaching is a direct manifestation of the quality of English teaching, which is mainly evaluated through the performance parameters directly related to the English teaching process in colleges. The author believes that the implementation results of English teaching in colleges can be subdivided into CET4 pass rate  $a_{31}$  for English majors, CET6 pass rate  $a_{32}$  for English majors, pass rate for English majors in professional courses  $a_{33}$ , excellent rate for English majors in professional courses  $a_{34}$ , and the award of English competitions for students  $a_{35}$ . CET4 and CET6 focus on assessing students' comprehensive English abilities, including English listening, reading, and writing; in terms of difficulty, CET4 and CET6 also can be clearly divided, to better distinguish students' English level. The pass rate and excellent rate of English majors' professional courses can reflect the comprehension, mastery and application ability of English majors in English, and effectively manifest the professional characteristics of English teaching. The English competition awards are a deeper assessment of English teaching, which focuses more on examining

the professionalism, applicability, and intensity of English teaching, reflecting the professional depth of English teaching from various aspects of English majors such as listening, speaking, reading, writing, and translation; the awards of students' English competitions can generally be evaluated and analyzed in terms of the number of college students participating in English competitions, the number of awards, and the proportion of awards.

#### 4. Ability improvement and performance of college English majors $A_4$

The ability improvement and performance of English majors in colleges is an indirect manifestation of college English teaching quality. The quality of English teaching is evaluated mainly by examining performance parameters that are not directly related to the English teaching process in colleges.

In this paper, the ability improvement of English majors in colleges can be subdivided into multiple parts such as English majors' innovation ability  $a_{41}$ , English majors' practical application ability  $a_{42}$ , English majors' employment and entrepreneurship  $a_{43}$ , and English majors' social serviceability  $a_{44}$ .

The innovation ability of English major students refers to the innovative qualities of English major students cultivated through English teaching to discover and solve problems. The practical application ability is to highlight the professional practice and application qualities of English majors. The employment and entrepreneurship of English majors can reflect the adaptability of the English majors cultivated in the society; the higher employment rate and the entrepreneurial success rate can indirectly reflect the improvement in the level and ability of English majors.

The social serviceability of English majors can verify whether college English teaching meets the needs of professional talents in the society and satisfies the society.

In summary, an evaluation system for English teaching quality with a hierarchical structure was established, as shown in Figure 1.

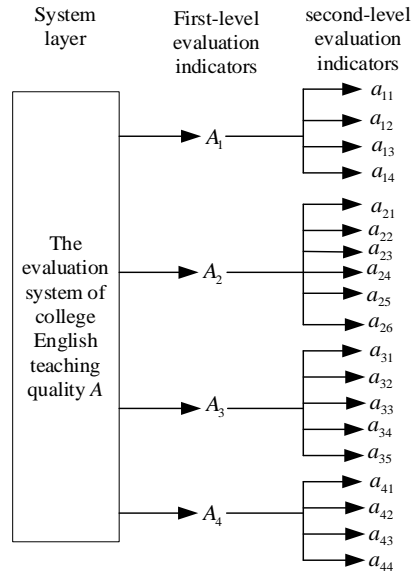


Fig. 1. The evaluation system of college English teaching quality

## 4 The Evaluation Model for College English Teaching Quality Based on Grey Clustering Analysis and Entropy Weight Method

### 4.1 Processing the evaluation indicators of college English teaching quality

The evaluation indicators for college English teaching quality are processed in two aspects: one is the unified dimensioning of evaluation indicators, transforming all the indicators into the index value or fuzzy membership of the same metric and further applying them to the grey clustering evaluation process of college English teaching quality; the second is to carry out the weighting of the evaluation indicators; due to the differences in the importance among different evaluation indicators, it's necessary to consider the influences of different index weights in the process of assessing the college English teaching quality, which can enhance the accuracy and reliability of the evaluation results.

It's assumed that the maximum value of the evaluation indicator  $a_j$  for college English teaching quality is  $V^{\Omega}(a_j)$ , the minimum value is  $V^{\cup}(a_j)$ , and the initial value of the evaluation object  $P_i$  about the evaluation indicator  $a_j$  is  $V_i(a_j)$ . If  $a_j$  is a positive index (that is, the larger the index value, the better the corresponding performance), then the unified standardized value is  $U_i(a_j)$ :



$$U_i(a_j) = \frac{V_i(a_j) - V^\square(a_j)}{V^\Omega(a_j) - V^\square(a_j)} \tag{1}$$

If  $a_j$  is a reverse index (that is, the larger the index value, the worse the corresponding performance), then the unified standardized value is  $U_i(a_j)$ :

$$U_i(a_j) = \frac{V^\Omega(a_j) - V_i(a_j)}{V^\Omega(a_j) - V^\square(a_j)} \tag{2}$$

To avoid the subjective influence in the process of evaluating college English teaching quality, the entropy weight method was used to solve the weight evaluation index [20-22]. The basic solution of this method is to determine the objective weight of the corresponding index based on the variability of the evaluation index. According to the physical meaning of information entropy, the evaluation indicator with smaller information entropy shall have more index variation, provide more information in the process of evaluating English teaching quality, and play a greater role. Thus, it occupies greater weight. Conversely, the evaluation indicator with greater information entropy shall have less index variation, provide less information in the evaluation process, and play a lower role, which results in a smaller weight. If the number of evaluation objects is  $m$ , then the information entropy of the evaluation indicators  $a_j$  can be expressed as  $E_j$ :

$$E_j = - \frac{\sum_{i=1}^m \left( \left( U_i(a_j) / \sum_{i=1}^m U_i(a_j) \right) * \ln \left( U_i(a_j) / \sum_{i=1}^m U_i(a_j) \right) \right)}{\ln m} \tag{3}$$

From this, the weight  $w_j$  of  $a_j$  can be obtained, namely:

$$w_j = \frac{1 - E_j}{\sum_{j=1}^N (1 - E_j)} \tag{4}$$

It indicates that the weight  $w_j$  of evaluation indicator  $a_j$  meets  $0 \leq w_j \leq 1$ , and

$$\sum_{j=1}^n w_j = 1.$$

Then the weight sequence  $\mathbf{W}$  of the evaluation indicators for English teaching quality in colleges is expressed as:

$$\mathbf{W} = (w_1, \dots, w_j, \dots, w_n) \tag{5}$$

### 4.2 Grey clustering analysis for college English teaching quality

The key to the grey clustering analysis of college English teaching quality is the establishment of grey-whitening weight functions corresponding to the grey class of English teaching quality evaluation indicators. Then, through the calculation of the grey whitening value, the grey class to which it belongs can be further obtained [23-26]. Different grey classes correspond to different evaluation levels, which can be set in accordance with the specific needs of the English teaching quality evaluation. Assuming that the number of college English teaching quality evaluation indicators is  $n$  and the number of grey classes is  $q$ , the grey whitening weight function  $\phi_{ij}(U)$  of the evaluation indicator  $j$  on gray classes  $i$  can be established in three forms.

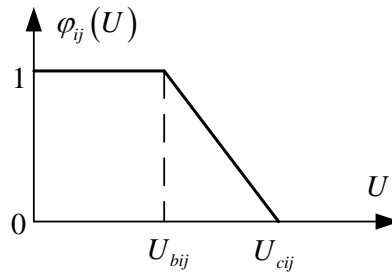


Fig. 2. The first grey whitening weight function

If the independent variable of this grey whitening weight function  $\phi_{ij}(U)$  has a value range of  $[0, U_{cij}]$ , and the independent variable center value of corresponding grey class is  $U_{bij}, U_{bij} \leq U_{cij}, U_{cij} \neq 1$ , then the structure of this grey whitening weight function is shown in Figure 2.

The corresponding calculation model of grey-whitening weight function calculation model  $\phi_{ij}(U)$  is given as:

$$\phi_{ij}(U) = \begin{cases} 1 & U_p(a_j) \leq U_{bij} \\ \frac{U_{cij} - U_p(a_j)}{U_{cij} - U_{bij}} & U_{bij} \leq U_p(a_j) \leq U_{cij} \\ 0 & U_p(a_j) \geq U_{cij} \end{cases} \quad (6)$$

where,  $U_p(a_j)$  is the standardized value of the evaluation object  $p$  about the evaluation indicator  $a_j$ .

If the independent variable of this grey whitening weight function  $\phi_{ij}(U)$  has a value range of  $[U_{aij}, U_{cij}]$ , and the independent variable center value of corresponding grey class is  $U_{bij}, U_{aij} \leq U_{bij} \leq U_{cij}, U_{cij} \neq 1$ , then the structure of this grey whitening weight function is shown in Figure 3.

The corresponding calculation model of grey-whitening weight function  $\phi_{ij}(U)$  is given as:

$$\phi_{ij}(U) = \begin{cases} \frac{U_p(a_j) - U_{aij}}{U_{bij} - U_{aij}} & U_{aij} \leq U_p(a_j) \leq U_{bij} \\ 0 & U_p(a_j) \leq U_{aij} \\ 1 & U_p(a_j) = U_{bij} \\ 0 & U_p(a_j) \geq U_{cij} \\ \frac{U_{bij} - U_p(a_j)}{U_{cij} - U_{bij}} & U_{bij} \leq U_p(a_j) \leq U_{cij} \end{cases} \quad (7)$$

If the independent variable of this grey whitening weight function  $\phi_{ij}(U)$  has a value range of  $[U_{aij}, 1]$ , and the independent variable center value of corresponding grey class is  $U_{bij}, U_{aij} \leq U_{bij}, U_{aij} \neq 0$ , then the structure of this grey whitening weight function is shown in Figure 4.

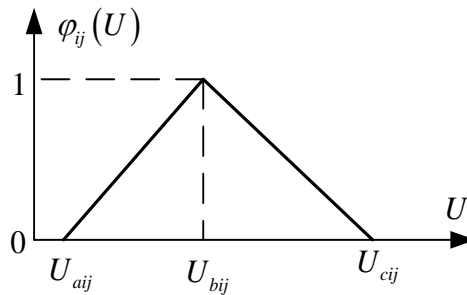


Fig. 3. The second grey whitening weight function

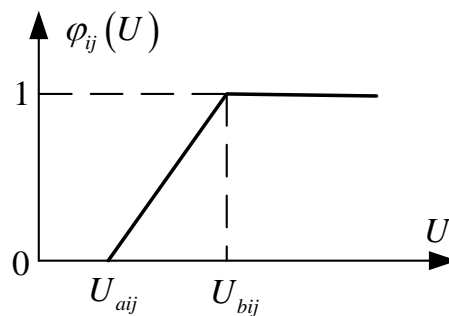


Fig. 4. The third grey whitening weight function

The corresponding calculation model of grey-whitening weight function  $\phi_{ij}(U)$  is given as:

$$\phi_{ij}(U) = \begin{cases} 0 & U_p(a_j) \leq U_{aij} \\ \frac{U_p(a_j) - U_{aij}}{U_{bij} - U_{aij}} & U_{aij} \leq U_p(a_j) \leq U_{bij} \\ 1 & U_p(a_j) \geq U_{bij} \end{cases} \quad (8)$$

According to the calculation models above, the authors obtained the grey whitening function value of evaluation object  $p$  about the evaluation index  $a_j$  in the grey class  $i$ , which is denoted as  $\phi_{ij}^p(U)$ . Considering the weight of the evaluation index for the college English teaching quality, its comprehensive weighted grey clustering coefficient  $\delta_i^p(U)$  of grey class  $i$  was achieved, namely.

$$\delta_i^p(U) = \sum_{j=1}^n (w_j * \phi_{ij}^p(U)) \quad (9)$$

From Formula (9), the comprehensive weighted grey clustering coefficient between different evaluation objects and different grey classes can be obtained. If this coefficient is the largest, it means that the evaluation object belongs to the grey class. Then, the evaluation level of the English teaching quality can be determined for this evaluation object.

## 5 Conclusion

Aiming at the problems with the evaluation of college English teaching quality, this paper presents a method for evaluating the quality of English teaching in colleges based on the grey clustering analysis. It firstly analyses the factors affecting the college English teaching quality. Based on this, an improved evaluation system of college English teaching quality was built. In addition, the grey clustering analysis and entropy weight method were combined to establish an evaluation model of English teaching quality in colleges and achieve the quantitative analysis for this. This study has a good guiding significance for solving complex decision-making problems.

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