



Research on Classroom Teaching Quality Evaluation in Colleges and Universities Based on Cloud Model

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Abstract. Classroom teaching quality evaluation (CTQE) has always played an important role in college's teaching systems and teaching quality management. Firstly, the evaluation criteria of college's CTQE is given by analyzing the university classroom teaching from teaching ideology and politics, teaching content and organization, and teaching methods and means; Then the weight of each evaluation criterion is obtained through the entropy weight method. Finally, after using the cloud model to convert the qualitative description into quantitative expression, the comprehensive evaluation method based on the normal cloud model is given, which can better solve the ambiguity and randomness of the teaching evaluation. An example calculated by MATLAB software is presented to illustrate the validity and feasibility of the evaluation method.

Keywords: entropy weight method · cloud model · classroom teaching quality evaluation

1 Introduction

Classroom teaching is the main form of quality education in colleges and universities at present, so the evaluation of classroom teaching quality has always been an important part of college's teaching systems and teaching quality management. Scientific and reasonable evaluation of classroom teaching quality is of great significance for correctly guiding teachers' teaching practice and reform and improving the quality of classroom teaching. In the existing evaluation criterion system of teaching quality in colleges, the evaluation value is mostly qualitative description, which has strong ambiguity. Moreover, the simple value assignment method, which is generally used to transform the qualitative description into quantitative data, fails to accurately reflect the true intention of the evaluator, which inevitably leads to the unreasonable results.

Cloud theory is a theory proposed by Li Deyi to solve the coexistence problem of ambiguity and randomness. Through a specific constructed algorithm, it forms the transformation between the qualitative concept and its quantitative representation, which reveals the internal correlation of ambiguity and randomness. The cloud model is expressed by three numerical features (E_x, E_n, H_e) , where E_x is the central value of the concept in the theory domain, and it is the value that best represents this qualitative concept. Entropy E_n is a measure of qualitative conceptual ambiguity, reflecting the range of values accepted by this concept. Hyperentropy H_e is the entropy of entropy E_n , reflecting the degree of dispersion of cloud droplets [1, 2]. At present, cloud model has been widely used in comprehensive evaluation, fuzzy decision and other aspects [3–5]. Cloud gravity center method [6] is a typical method evaluated by cloud model, and many researchers have achieved good results in applying it to their respective fields. In literature [7], the cloud gravity center evaluation method was applied to researching income distribution of mineral resources development; In literature [8], the fuzzy extension hierarchical analysis method and cloud gravity evaluation method were applied to guiding enterprise management; To accurately evaluate the performance of portable devices, literature [9] proposed a portable equipment performance evaluation method based on cloud gravity center evaluation method; Literature [10] introduced cloud model into network security situation evaluation, and proposed a network security evaluation method based on cloud gravity center evaluation method.

The rest of this paper is organized as follows. Based on the analysis of teaching ideology and politics, teaching content and organization, teaching methods and means, Sect. 2 gives the evaluation criterion system of colleges' classroom teaching quality; Sect. 3 gives the expectation curve equation of normal cloud model, integrating cloud formula and entropy weight method, then the process of CTQE method based on cloud gravity center is proposed. Section 4 gives an example of CTQE in a college, which verifies that the method of this paper can better solve the ambiguity and randomness of qualitative description in the evaluation, and make the CTQE more scientific and reasonable; Some summary remarks are given in Sect. 5.

2 Establishment of the Evaluation Criterion System of COLLEGE'S Classroom Teaching Quality

According to the characteristics and reality of classroom teaching in colleges, the college's CTQE system is given from three aspects: teaching ideology and politics, teaching content and organization, teaching methods and means.

2.1 Teaching Ideology and Politics

According to the requirements of Chinese President Xi Jinping at the National Conference on Ideological and Political Work in Colleges and Universities, *all kinds of courses and ideological and political theory courses are oriented in the same way as students, forming a synergistic effect*, so the CTQE in colleges and universities must include,

- (1) Carry out the ideological and political courses according to the course content, and guide students to establish a positive outlook on life, world outlook and values;

- (2) Serious and responsible in class, full teaching preparation, proper words and deeds, full of teaching spirit, patient guidance and answering questions.

2.2 Teaching Content and Organization

Teaching content and organization have always been the core content of classroom teaching in colleges and universities. Classroom teaching in colleges and universities must meet the following requirements,

- (1) Clear teaching requirements, pay attention to the docking with the first course (content), design teaching ideas according to the teaching content and students' existing level, and reasonable arrangement of each link and time allocation;
- (2) The teaching content is substantial and highly targeted, which can better reflect or contact the new ideas, new concepts and new achievements of the development of the discipline, and serve the course objectives and graduation requirements;
- (3) The knowledge point in teaching is accurate, and the key and difficult points are prominent, which can effectively help students to establish the knowledge theory system;
- (4) Pay attention to guiding students to use the knowledge and principles to solve practical complex engineering (practice) problems.

2.3 Teaching Methods and Means

Teaching methods and means are not only the tools to achieving the teaching objectives, but also an important link to reflecting the quality of teachers' classroom teaching. College teachers must do it in classroom teaching,

- (1) Skilled and effective use of information teaching methods, provide sufficient learning resources, and help students to achieve the course objectives;
- (2) Be good at asking questions, pay attention to the use of process evaluation, stimulate students' interest in learning, and give students thinking, association, innovation and enlightenment.

Based on the above contents, the evaluation criterion system of CTQE in colleges and universities can be established as Table 1.

3 Evaluation Method of COLlege's CTQE Based on Cloud Gravity Center

3.1 Normal Cloud Model

The expectation curve for the normal clouds is $y = \exp[-(x - E_x)^2/2E_n^2]$, where numerical characteristics E_x is the central value of the concept in the theoretical domain, and entropy E_n is a measure of qualitative conceptual ambiguity. Hyperentropy H_e is the entropy of entropy E_n , which reflects the degree of dispersion of cloud droplets, as Fig. 1,

Table 1. The evaluation criterion system of college’s CTQE

The first-rank criterion	The second-rank criteria
Teaching ideological and political education C_1	Curriculum ideological and political C_{11}
	Teaching manners and attitude C_{12}
Teaching content and organization C_2	Whether the teaching content arrangement is reasonable C_{21}
	The pertinence of the teaching content C_{22}
	Accuracy of the teaching content C_{23}
	Combine teaching content with practice C_{24}
Teaching methods and means C_3	Information application C_{31}
	Teaching interaction C_{32}

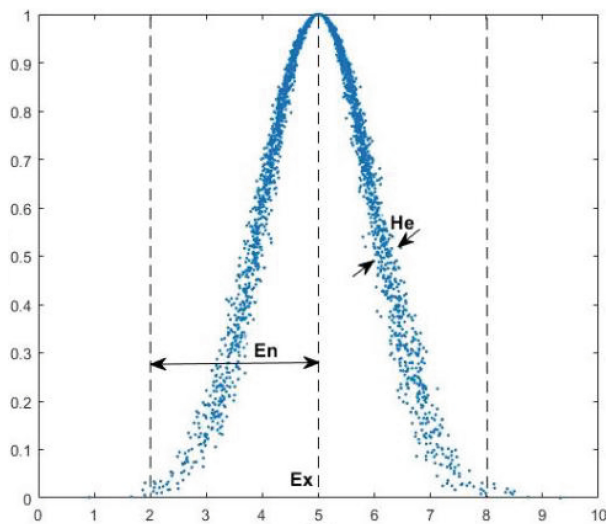


Fig. 1. Diagram of the numerical characteristics of the cloud

3.2 Integrated Cloud Computing

The comprehensive cloud is used to synthesize two or more language values of the same type into a broader language value. The following formulas can be used to generate an integrated cloud (E_x, E_n, H_e) from the n base clouds $(E_{x_i}, E_{n_i}, H_{e_i}), i=1,2, \dots, n$.

$$\begin{cases} E_x = \sum_{i=1}^n (E_{x_i} E_{n_i}) / \sum_{i=1}^n E_{n_i} \\ E_n = \sum_{i=1}^n E_{n_i} \\ H_e = \sum_{i=1}^n (H_{e_i} E_{n_i}) / \sum_{i=1}^n E_{n_i} \end{cases} \quad (1)$$

3.3 Cloud Modelling Processing of Criterion Value

According to the language value of the criterion, the language value can be quantified into an interval number $[C_{min}, C_{max}]$, then the following formula is used for the cloud modelling processing:

$$E_x = (C_{max} + C_{min})/2, E_n = (C_{max} - C_{min})/6 \tag{2}$$

where H_e can be adjusted according to the uncertainty and randomness of specific indicators.

3.4 The Criterion Weight Determination Method of CTQE Based on Entropy Weight Method

According to the criterion system of CTQE, experts are organized to score the classroom teaching of college teachers, and the score matrix is $X = (x_{ij})_{n \times m}$, where n is the number of participating teachers, m is the number of evaluation indicators. The process of determining the weights is performed as follows:

(1) The score data were pre-processed by the follow formula

$$P_{ij} = x_{ij} / \sum_{j=1}^m x_{ij} \tag{3}$$

(2) Seek criterion information entropy by formula

$$E_j = -k \sum_{i=1}^n (P_{ij} \ln P_{ij}), k = 1 / \ln n. \tag{4}$$

(3) Calculate the criterion weight. The weight of the j th criterion is

$$w_j = (1 - E_j) / (m - \sum_{j=1}^m E_j) \tag{5}$$

3.5 The Vector of Cloud Gravity Center

The n evaluation criteria can be expressed by a n -dimension comprehensive cloud. When the system state reflected by the n indicators is different, their shape also changes, and the cloud gravity center also changes accordingly. The integrated cloud gravity center is represented by a n -dimension vector $G = (G_1, G_2, \dots, G_n)$, where $G_i = a_i \times b_i$, ($i = 1, 2, \dots, n$), a_i is position vector of the cloud gravity center, b_i is height vector of the cloud gravity center, namely weight vector [6].

3.6 Weighted Deviation Degree

Let the vector of cloud gravity center be $G^0 = (G_1^0, G_2^0, \dots, G_n^0) = a^0 \times b^0$, where $a^0 = (a_1^0, a_2^0, \dots, a_n^0)$, $b^0 = (b_1^0, b_2^0, \dots, b_n^0)$. Let the system state be at some time

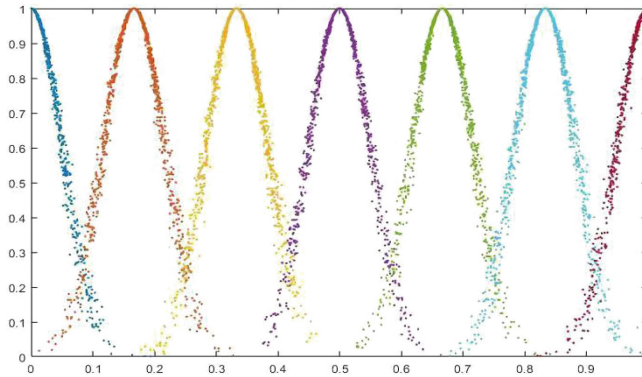


Fig. 2. Cloud generator to evaluate the results

$G = (G_1, G_2, \dots, G_n)$, then normalization was performed to obtain the dimensionless vector $G' = (G'_1, G'_2, \dots, G'_n)$, where

$$G'_i = \begin{cases} (G_i - G_i^0)/G_i^0, & G_i < G_i^0 \\ (G_i^0 - G_i)/G_i, & G_i \geq G_i^0 \end{cases} \quad i = 1, 2, \dots, n. \quad (6)$$

So the weighted deviation degree is $\theta = \sum_{i=1}^n w_i G'_i, -1 < \theta < 0$.

3.7 Cloud Generator to Evaluate the Results

Divide the comment value into seven levels, and the cloud model can get the cloud generator, as Fig. 2. The final evaluation results is obtained by inputting the evaluation value into the cloud generator.

3.8 Evaluation Steps of Classroom Teaching Quality

According to the above cloud theory method, a new evaluation method can be obtained from the criterion system of CTQE. The specific steps are described as follows:

Step1 Organize experts to evaluate the teaching quality of the university teachers according to the criterion of CTQE, and give the evaluation language value and the corresponding interval number;

Step2 The interval number given by each expert is modeled by cloud theory, and comprehensive cloud computing is conducted for the various cloud model of the same evaluation criterion;

Step3 According to 3.4, experts are organized to score the weight of each evaluation criterion and determine the weight of each criterion;

Step4 The ideal value of the college’s CTQE system is given, and the vector of comprehensive cloud gravity center and the weighted deviation degree θ are calculated by MATLAB software;

Step5 After inputting the evaluation value $P = 1 + \theta$ into the evaluation cloud generator in Fig. 2, the final evaluation result of CTQE is obtained according to the activated cloud object.

Table 2. The numerical characteristics of cloud model for each criterion

critierion	E_x	E_n	H_e
C ₁₁	0.82	0.04	0.04
C ₁₂	0.85	0.03	0.02
C ₂₁	0.75	0.07	0.01
C ₂₂	0.77	0.04	0.03
C ₂₃	0.89	0.08	0.04
C ₂₄	0.74	0.04	0.05
C ₃₁	0.85	0.05	0.06
C ₃₂	0.65	0.03	0.02

4 Illustrative Example

Take a university teacher as an example. According to 3.8, evaluated by the expert group, the numerical characteristics of cloud model for each evaluation criterion of the teacher was obtained as Table 2. According to 3.4, by using MATLAB to write calculation program, the available weight vector is $w=[0.14 \ 0.12 \ 0.13 \ 0.13 \ 0.16 \ 0.12 \ 0.10 \ 0.10]$. The vector of cloud gravity center is $G'=(0.1148 \ 0.1020 \ 0.0975 \ 0.1001 \ 0.1424 \ 0.0888 \ 0.0850 \ 0.0650)$ according to Equation (6). According to the criterion system of CTQE, each criterion is an profit index, so the ideal state vector is $a^0 = [1]$ and the ideal vector of cloud gravity center is $G^0 = (G_1^0, G_2^0, \dots, G_8^0)=(0.14 \ 0.10 \ 0.13 \ 0.16 \ 0.10 \ 0.09 \ 0.07 \ 0.08)$. So $\theta=-0.2044$ calculated from equation (7). After inputting $P = 1 + \theta = 0.7956$ into the cloud generator model, the “good” and “good” objects, more than “good”, is activated. Then the final evaluation result of the teacher’s classroom teaching quality is good.

5 Conclusion

Scientific and reasonable evaluation of CTQE plays an important role in guiding teaching reform and improving the quality of classroom teaching. This paper mainly conducts the following work: (1) According to the characteristics of classroom teaching, the criterion system of CTQE in colleges and universities is given; (2)The evaluation interval number is transformed into the cloud model by cloud theory, and the evaluation value is integrated by the comprehensive cloud algorithm; (3) the weight determination method and a new CTQE method based on the cloud model are given, which make the CTQE in colleges and universities more scientific and reasonable. Finally, an example calculated by MATLAB proves the validity and rationality of this evaluation method.

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