Evaluation method of English flipped classroom teaching effect based on entropy weight method

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Abstract: In the existing English flipped classroom, the evaluation accuracy of teaching effect is low. This paper presents an evaluation method of English flipped classroom teaching effect based on entropy weight method. The tower structure is used to divide the evaluation indicators of English flipped classroom teaching effect and determine the first-class indicators and second-class indicators. First the evaluation index is standardised, and the index preprocessing is completed. Then original index matrix is determined and standardised. The index entropy, by using the entropy weight method, is calculated. Then, the index weight calculation is completed, and the multiple regression evaluation model for the evaluation of the English flipped classroom teaching effect is established. Input the index into the model. The results, obtained by using the contribution rate calculation, are corrected, and finally, the effect evaluation is completed. The results show that the evaluation accuracy of this method is higher than 90%.

Keywords: entropy weight method; English flipped classroom; teaching effect; normalisation; entropy; multiple regression evaluation model.

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1 Introduction

With the continuous in-depth reform of education in China, flipped classroom has become a more popular teaching form in current teaching. Compared with the traditional classroom teaching mode, this new classroom breaks the rigid mode in the traditional teaching, subverts the limitations of classroom teaching by time and space, and gives students more space for autonomous learning (El-Sayed et al., 2019). It not only improves students' interest in learning, but also effectively improves the quality of

teachers' teaching. In order to continuously improve the quality of flipped classroom teaching, it is very important to effectively evaluate its classroom effect (Harari, 2019). Teaching evaluation needs multi angle, multi-dimensional and dynamic evaluation based on relevant effects and results. At present, the evaluation of teaching effect mainly depends on the attitude of teachers and students, and there is often a certain subjectivity in the evaluation process (Guo et al., 2019). Therefore, researchers in this field have done a lot of research on the evaluation methods of classroom teaching effect, and achieved some results.

Gu (2020) proposes a method of using neural network to evaluate teaching quality. By determining the current situation of classroom teaching quality evaluation, the proportion of teaching quality evaluation indexes is calculated with the help of grey correlation analysis method, and the neural network training evaluation index data is used to classify and evaluate through the classified data. The evaluation process of this method is relatively simple and the operation efficiency is high, but the construction of the evaluation index system is not detailed, and there are some errors in the results, which need to be continuously improved. Zhang (2019) puts forward a new model of teaching quality evaluation. In the design of the model, the multidimensional index data of evaluation is determined, the relevant measurement system is constructed, and the data is divided and preprocessed in detail. Take these determined data as in and out data, build a model with the help of active learning support vector mechanism, and then input the training data to complete the final evaluation. The evaluation index system constructed by this method is more detailed, but the data input into the evaluation model can not control the convergence of the results, which has some disadvantages, so it is necessary to limit the convergence of the training data. Yun and Wang (2019) put forward the method of evaluating teaching quality by video analysis method. Based on the analysis of the current situation and utilisation rate of online course video, this method first analyses the teaching content in the video, and improves the quality of classroom teaching through the skills and attraction of video teaching. Then it analyses the user's favourite degree after watching in video teaching, takes this as the basis, analyses the attraction factor, and constructs the evaluation method. This method meets the requirements of evaluation in theory, but it has not been practiced. It needs to get effective results after practice.

In order to improve the quality of English flipped classroom teaching effect, aiming at some deficiencies in the existing methods, this paper proposes to design an evaluation method of English flipped classroom teaching effect based on entropy weight method.

The technical route of this paper is as follows:

Step 1   Use the tower structure to divide the evaluation indicators of English flipped classroom teaching effect, and determine the first-class indicators and second-class indicators. Among them, the first level indicators include flipped classroom teachers' ability, flipped classroom activity, flipped classroom teaching methods and the first level students' enlightenment ability; secondary indicators include teachers' speaking speed and guidance; students' reaction ability, multimedia technology, task driven and so on.

Step 2   Normalise the evaluation index of English flipped classroom teaching effect, cluster the data with similar attributes and values, and finally determine the evaluation index data of English flipped classroom teaching effect through dimensionless, so as to complete the preprocessing of English flipped classroom teaching effect evaluation index.

Step 3   In the weight calculation of English flipped classroom teaching effect evaluation index, determine the original English flipped classroom teaching effect evaluation index matrix and standardise it. On this basis, calculate the entropy of English flipped classroom teaching effect evaluation index through entropy weight method, and complete the weight calculation of primary index and secondary index.

Step 4   On this basis, build a multiple regression evaluation model for the evaluation of English flipped classroom teaching effect, input the evaluation index of English flipped classroom teaching effect into the model to obtain the final result, and modify the output result of the evaluation model with the help of the calculation of contribution rate to complete the evaluation of English flipped classroom teaching effect.

2   Determination and pretreatment of evaluation index of English flipped classroom teaching effect

In order to achieve the goal of this study, we first need to determine the evaluation indicators of English flipped classroom teaching effect, and effectively process the determined index data, so as to lay a certain data foundation for the subsequent goal realisation. In the evaluation index of English flipped classroom teaching effect, due to the large amount of data, the determined index only selects the more key and important data.

### 2.1   Determination of evaluation index of English flipped classroom teaching effect

The determination of indicators in the evaluation of English flipped classroom teaching effect is the first step to achieve the research goal. In the evaluation of English flipped classroom teaching, the primary consideration is the subject of participation. It mainly includes students and teachers. The success of flipped classroom teaching is directly related to the two, which is the key to the success of teaching (Gündoğdu and Kahraman, 2020). Therefore, the determination of evaluation index data is an important factor to improve the accuracy of evaluation.

In this paper, the tower structure is used in the determination of indicators for the evaluation of classroom teaching effect (Oztekin et al., 2018). The effect evaluation indicators are divided into several different levels of indicators, which are divided layer by layer. The more levels are divided in the index evaluation, the higher the effectiveness of the indicators. The hierarchical structure of indicators is shown in Figure 1.

In the evaluation index of flipped classroom teaching effect in this paper, teachers' teaching ability, attitude, content and popularity are taken as the primary index of this paper, which is divided down in detail according to the set primary index. The determination of evaluation indicators affects the effect of flipped classroom teaching. Therefore, the evaluation indicators determined in this paper are the key indicators related to the classroom, which can meet the needs of this paper.

The evaluation indexes of flipped classroom teaching effect determined in this paper are shown in Table 1.

Figure 1   Layered model of flipped classroom teaching effect evaluation index
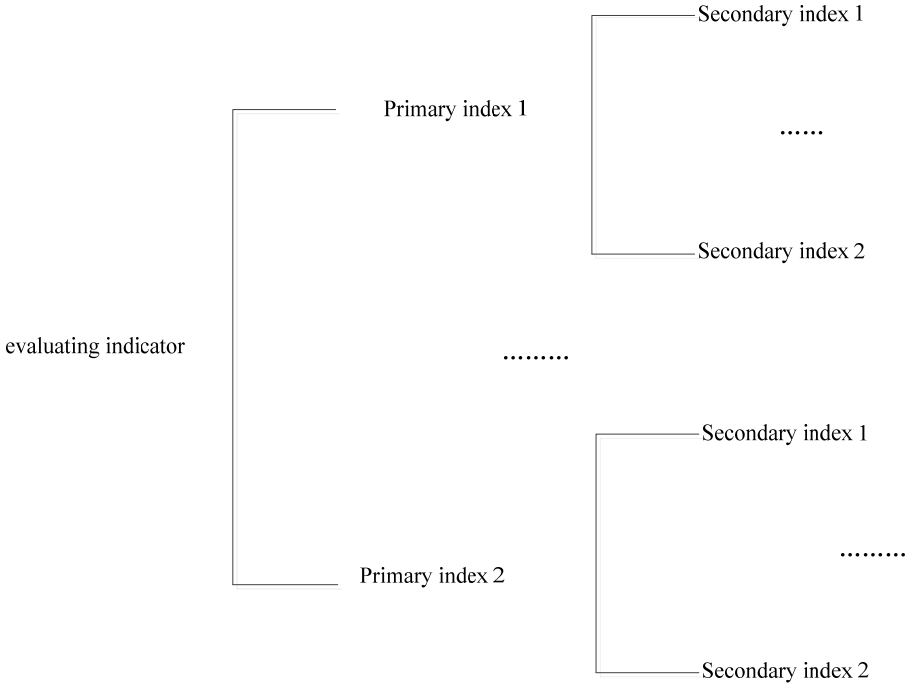
Table 1   evaluation index of flipped classroom teaching effect

Primary index	Content	Secondary indicators	Content
A_1	Flip the classroom teacher abilities	a_1	Teacher language speed, guidance degree and so on
A_2	Flip over the classroom activity	a_2	Students' ability to respond
A_3	Flip the classroom teaching methods	a_3	Multimedia technology, task-driven, etc
A_4	Flip over the classroom teaching content	a_4	Correct, contact with reality, etc.
A_4	Students' enlightenment ability	a_5	Students' learning interest, etc.

In determining the evaluation index of English flipped classroom teaching effect, the tower structure is used to divide the evaluation index of English flipped classroom teaching effect, and the first-class index and second-class index are determined. According to the above determined evaluation indicators of flipped classroom teaching effect, it provides a basis for subsequent evaluation.

2.2   Pretreatment of evaluation indexes of English flipped classroom teaching effect

Based on the above determined evaluation index data of English flipped classroom teaching effect, in order to improve the effectiveness of the evaluation results. The

evaluation indexes determined above need to be preprocessed (Kansal et al., 2020). There are a large number of primary and secondary indicators in the evaluation index data of English flipped classroom teaching effect, among which the attributes of multiple indicators are relatively similar and the difference is small. Therefore, firstly, normalise the evaluation index data of English flipped classroom teaching effect, avoid the data with high attribute covering the data with low attribute, and normalise the evaluation index data to [0, 1] Within the scope of, i.e.:

$$A_i^* = \frac{A_i - A_{\min}}{A_{\max} - A_{\min}} \tag{1}$$

Among them, A_i represents the index data entered, $A_{\min}$ represents the minimum data value in the index data entered, $A_{\max}$ represents the maximum data value in the index data entered.

On the basis of the normalised English flipped classroom teaching effect evaluation index data, the data with similar attributes and values should be gathered, so as to facilitate the classification of the evaluation index data with the same attributes, that is:

$$B = \sum_{i=1}^{n} \sum_{j=1} |A_i - H_j| \tag{2}$$

Among them, H_j represents the data clustering centre for English flipped classroom teaching effect evaluation indicators, B represents the data clustering distance of English flipped classroom teaching effect evaluation index.

To determine whether the data after English flipped classroom teaching effect evaluation index data clustering is unified attribute data, the variance calculation method is adopted (Baiges et al., 2020), i.e.:

$$\tau^2 = \frac{c\max}{\sqrt{v}} \tag{3}$$

Among them, $c\max$ indicates the maximum European distance between the evaluation indicators of English flipped classroom teaching effect, v represents the data from the distance centre.

Since the data of classroom teaching effect is affected by the number and outline, and there is no comparative performance between them, further dimensionisation of the data is needed (Isabel and Benjamin, 2019). Assuming m interference data in the classroom teaching effect evaluation index data and n data sequences among the interference factors, the initial interference data sequence is a matrix of $n \times m$, then:

$$V = \left(f_{ij} \right)_{n \times m} \tag{4}$$

In type, f_{ij} represents the interference data matrix.

The data matrix is represented as:

$$V' = \left(f_{ij} \right)'_{n \times m} \tag{5}$$

1   The unless processing of classroom teaching effect evaluation index includes the processing of three values, namely:

Initialise the English flipped classroom teaching effect evaluation index data, namely:

$$A'_{ij} = \frac{A_{ij}}{A_{Ij}} \tag{6}$$

2   Mean English flipped classroom teaching effect evaluation index data, that is:

$$A'_{ij} = \frac{A_{ij}}{\overline{A_i}} \tag{7}$$

3   Extreme mal English flipped classroom teaching effect evaluation index data, that is:

$$= \frac{A_{ij} - \overline{A_i}}{k_j} \tag{8}$$

Among them, k_j represents the standard deviation.

The outline results of the above three English flipped classroom teaching effect evaluation data are consolidated, and the final English flipped classroom teaching effect evaluation data is:

$$A'_{ij} = \mu \frac{A_{ij}}{\sqrt{\sum_{i=1}^{n} A_{ij}^2 \rho}} \tag{9}$$

Among them, μ represents the resolution coefficient, ρ represents the maximum difference.

In the pre-processing of English flipped classroom teaching effect evaluation index, normalise the English flipped classroom teaching effect evaluation index, cluster the data with similar attributes and value, and finally determine the English flipped classroom teaching effect evaluation index data, and complete the preprocessing of English flipped classroom teaching effect evaluation index.

2.3   Construction of evaluation model of English flipped classroom teaching effect based on entropy weight method

According to the above preprocessed English flipped classroom teaching effect evaluation indicators, in order to improve the advantages of English flipped classroom teaching effect evaluation, it is necessary to calculate the weight of English flipped classroom teaching effect evaluation indicators. In this paper, the entropy weight method is used to calculate the weight of the evaluation index of English flipped classroom teaching effect, so as to provide more accurate index data for subsequent evaluation (Lu and Fang, 2020). Entropy weight method takes an index as the observation value of the sample, determines the influence of the observation value and gives it a weight value. This method is also a classical key value assignment method. The size of the evaluation index is the entropy value in the entropy weight. The calculation of this value is helpful to improve the evaluation effect.

In the weight assignment of this paper, first determine the original English flipped classroom teaching effect evaluation index matrix, set m English flipped classroom

teaching effect evaluation, n English flipped classroom teaching effect evaluation indicators to be evaluated, and set the original English flipped classroom teaching effect evaluation index matrix as follows:

$$E = \begin{bmatrix} e_{11}, e_{12}, \ldots, e_{1n} \\ e_{21}, e_{22}, \ldots, e_{2n} \\ \ldots \\ e_{m1}, e_{m2}, \ldots, e_{mn} \end{bmatrix} \tag{10}$$

Among them, *e* represents the factors of the evaluation.

Standardise the original English flipped classroom teaching effect evaluation index matrix, namely:

$$G_i = n \frac{e_{mn}}{\sum_{i=1}^{n} e_{mn}} \varepsilon \tag{11}$$

Among them, *n* represents the number of indicators in the original matrix, *ε* represents the specification specific gravity.

Based on this, the entropy of the English flipped classroom teaching effect evaluation index is calculated by the entropy method, namely:

$$S_i = -l \sum_{j=1}^{mn} G_i \ln Q \tag{12}$$

Among them, S_i represents the entropy value of the indicator, *Q* represents the Boltzman coefficient.

In the process of the entropy calculation of the flipped classroom teaching effect evaluation index, due to the influence of different indicators, it is necessary to determine the difference coefficient of the indicators, i.e.:

$$C = 1 - S_i \tag{13}$$

Among them, *C* represents the coefficient of difference.

On this basis, the entropy method is used on the weight of English flipped classroom teaching effect, namely:

$$\varphi_i = \frac{S_i}{\sum_{i=1}^{m} C} \tag{14}$$

According to the primary weight value of the English flipped classroom teaching effect evaluation index, the calculation formula is:

$$P2 = \frac{E_i}{\sum_{i=1}^{m} \varphi_i} \tag{15}$$

Among them, the *P2* represents the secondary index weight value.

According to the weight value of the determined primary and secondary indicators, the English flipped classroom teaching effect evaluation model is constructed to realise the research of English flipped classroom teaching effect evaluation. The teaching effect evaluation model is first constructed by using a multiple regression model. The random

index in the English flipped classroom teaching effect evaluation index is z, the general index is y_1, y_2, ..., y_p. The linear regression model of the English flipped classroom teaching effect evaluation is:

$$z = \alpha_0 + \alpha_1 y_1 + \alpha_2 y_2 + \ldots + \alpha_p y_p + \delta \tag{16}$$

Among them, α represents an unknown indicator parameter, p represents constant, δ represents random error indicators.

According to this model, the evaluation index of English flipped classroom teaching effect is input into the constructed multiple regression model to obtain the evaluation effect value (Amenta et al., 2020). Because the results obtained by the constructed evaluation model are affected by the contribution rate of the evaluation index, resulting in the results have a certain deviation, therefore, the contribution rate of the evaluation index realises the comprehensive evaluation when the contribution rate reaches a certain extent. The contribution rate calculation formula of the evaluation index is:

$$d_i = \frac{\gamma_k}{\sum_{i=1}^{p} \gamma_i} \tag{17}$$

Among them, d_i represents the contribution rate, and γ_i represents the index contribution component value.

On this basis, to further evaluate the teaching effect of English flipped classroom, construct the final comprehensive evaluation function, and complete the research of the method, that is:

$$U(x) = \left(\alpha_1 y_1 + \alpha_2 y_2 + \ldots + \alpha_p y_p\right) \Big/ \sum_{i=1}^{n} d_i \tag{18}$$

In the weight calculation of English flipped classroom teaching effect evaluation index, the original English flipped classroom teaching effect evaluation index matrix is determined and standardised. Based on this basis, the entropy value of English flipped classroom teaching effect evaluation index is calculated through entropy method, and then the weight value calculation of primary index and secondary index is completed.On this basis, a multiple regression evaluation model of English flipped classroom teaching effect evaluation is constructed, and the evaluation index of English flipped classroom teaching effect is input to the final result. The result corrects the output result of the evaluation model, and the evaluation of English flipped classroom teaching effect is completed.

3   Experimental analysis

3.1   Design of experimental scheme

Based on the above method design, an experimental analysis is designed. Experimental with a university sophomore as the research object, the class has a total of 50 students, the class of the professional business English, among them, 35 for girls, 15 for boys, the class for 3 months flipped classroom teaching mode, to the class within the traditional teaching model as the comparison object, after the analysis of flipped classroom teaching mode, the class learning performance and learning enthusiasm changes. The collected

student-related data will be stored in the experiment, and the obtained evaluation results will be preprocessed through the data processing SPSS software. The experiment-related parameters are shown in Table 2.

Table 2 Experimental parameter setting

Parameter	Data
Experimental system	WINDOWS XP
Evaluation data amount (GB)	2
Sample data noise (dB)	-2-1
Number of evaluations (times)	100
Data error range	[0-0.2]

3.2 Index design

According to the above, the experiment compares the paper method, Zhang (2019) method and Yun and Wang (2019) method. The indexes of the experimental test include the accuracy of English flipped classroom teaching effect evaluation and the accurate weight calculation of English flipped classroom teaching effect evaluation index. The effectiveness of the data is ensured in the experiments.

3.3 Analysis of experimental results

3.3.1 Precision comparison of English flipped classroom teaching effect evaluation

The experimental analysis of the paper method, Zhang (2019) method and Yun and Wang (2019) method on the accuracy of English flipped classroom teaching effect evaluation.The higher the accuracy value represents the higher the evaluation effect. In order to improve the accuracy of the experiment, two sets of accuracy are analysed respectively. The results are shown in Figure 2.

It can be seen from Figure 2 that there are some differences in the accuracy of this method, Zhang (2019) method and Yun and Wang (2019) method in evaluating the effect of English flipped classroom teaching in the two experiments. Among them, from the curve trend, the evaluation effect of this method is better than the other two methods. And the evaluation accuracy of this method is always more than 90%. It can be seen that the performance of the proposed method is better. This is because this method uses the tower structure to divide the evaluation indicators of English flipped classroom teaching effect, and determine the first-class indicators and second-class indicators. Normalise the evaluation indicators, cluster the data with similar attributes and values, determine the index data through dimensionless, build a multiple regression evaluation model for the evaluation of English flipped classroom teaching effect, input the indicators into the model, and then improve the evaluation accuracy of this method.

Figure 2   Precision comparison results of English flipped classroom teaching effect evaluation
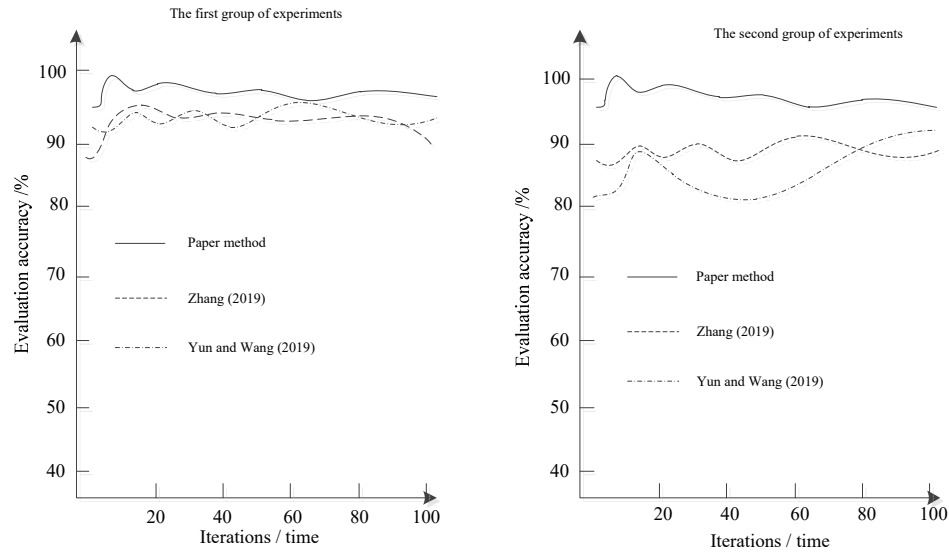
3.3.2   The accuracy of English flipped classroom teaching effect

The accuracy of the method, the Zhang (2019) method and the Yun and Wang (2019) method on the English flipped classroom teaching method is shown in Table 3.

Table 3   Weight calculation accuracy of English flipped classroom teaching effect evaluation index is (%)

Calculation times (times)	Methods of this paper	Zhang (2019)	Yun and Wang (2019)
10	95	89	87
20	94	86	85
30	95	82	84
40	95	84	86
50	96	82	84
60	94	83	85
70	95	84	85
80	95	80	86
90	93	82	84
100	94	81	86

By observing the experimental results in Table 3, we can know that the accuracy of this method, Zhang (2019) method and Yun and Wang (2019) method in calculating the weight of evaluation index of English flipped classroom teaching effect is different. Among them, the accuracy of using this method to calculate the weight of the evaluation index of English flipped classroom teaching effect is higher than the other two methods, and its maximum value is about 96%. Although the accuracy of the other two methods is within a reasonable range, the accuracy of this method is higher than that of the other two

methods. This is because this method calculates the index entropy through the entropy weight method, completes the weight value calculation of the primary index and the secondary index, calculates the indexes at different levels, improves its accuracy, and provides good data for the evaluation results.

4 Conclusions

In order to improve the quality of English flipped classroom teaching, this paper proposes a new evaluation method of English flipped classroom teaching effect based on entropy weight method. Through the grading and preprocessing of English flipped classroom teaching indicators, the entropy weight method is used to calculate the weight of evaluation indicators, and the evaluation model is constructed to complete the evaluation of English flipped classroom teaching effect. Experiments show that this method has the following advantages:

1 using the method proposed in this paper to evaluate the effect of English flipped classroom teaching has high accuracy and certain credibility

2 the weight calculation accuracy of the evaluation index determined by the method proposed in this paper is always higher than 90%, which verifies that the evaluation index of this method is feasible.

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