Evaluation Method of Online Learning Process Under the Background of Educational Big Data

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Abstract. In the actual evaluation of learning process, affected by online non process data, the evaluation index system is confused, resulting in the problem of low confidence of the final evaluation results. This paper designs an online learning process evaluation method under the background of educational big data. Set up the online learning process acquisition network, collect online learning process data, divide the collected learning process data according to the technical direction and teaching design direction, construct the index type system, regard the same level of indicators as a whole to distribute the weight, according to the weight value, build the evaluation process, and complete the design of process evaluation method. After setting the experimental parameters and delimiting the experimental samples, the evaluation method in reference [3], the evaluation method in reference [6] and the evaluation method designed in the paper are used to carry out the experiment. The results show that the confidence result of the evaluation method designed in this paper is the largest.

Keywords: Education big data · Online learning · Process · Non process data

1 Introduction

With the successful application of computer technology and network technology in the field of education, network learning has gradually become one of the important learning methods in modern society. It extends learning from walled campus to virtual network, making full use of the advantages of network technology to make up for the shortcomings of traditional education. Network learning has changed the traditional teaching mode. The teaching center has changed from teachers to students, and students have become active knowledge constructors. E-learning has many advantages, such as rich learning resources, various interaction types and autonomous learning methods, but it faces new problems in the process of practice.

Due to the separation of teachers and students in e-learning, teachers can not supervise students face to face. Students mainly rely on self-awareness and self-control for autonomous learning, which makes students' online learning efficiency low and the effect of online learning poor. The process evaluation of web-based learning has become an

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effective method to ensure the quality of online learning. Online learning process evaluation can help teachers master the learning progress and learning effect of students. However, there are some problems in the current online learning process evaluation, such as unified evaluation scheme, unable to make teachers flexibly adjust according to the needs of the curriculum, simple way to transform evaluation data into performance, and less feedback information of evaluation. How to evaluate the process of e-learning effectively is still in constant exploration.

The research on online learning process evaluation at home and abroad is mainly reflected in three aspects: evaluation theory research, evaluation technology research and application research. Considering the uniqueness of e-learning, foreign researchers have established an E-learning Evaluation System from four aspects of students' curriculum resources, learning attitude, communication and cooperation, and knowledge effect based on the analysis of students' learning behavior. Some scholars propose to use the hybrid algorithm of Bayesian and neural network to evaluate [3]; Some scholars propose to model and analyze big data [4]; Some scholars put forward structured analysis based on social network data for evaluation [5];Some scholars propose to use cloud computing for data mining, association and retrieval of key features to achieve evaluation [6].From the application of online learning process evaluation at home and abroad, it can be found that the current online learning evaluation has gradually paid attention to the students' learning process and learning results, but there are still some problems, such as the evaluation content is not comprehensive enough, the evaluation scheme can not be flexibly adjusted according to the curriculum requirements, and the evaluation data transformation method is simple.

2 Evaluation Method of Online Learning Process Under the Background of Educational Big Data

2.1 Collect Online Learning Process Data

Online learning has a wide range of knowledge sources, so we should analyze its knowledge sources and web access process when collecting. The knowledge involved in the online learning process is divided into internal knowledge organization level and external knowledge organization service level, and the online learning knowledge sources are integrated into a large collection network, as shown in Fig. 1.

The source of online knowledge base in Fig. 1 is divided into four parts: intelligence knowledge base, online learning data collection, comprehensive knowledge base and knowledge consultation. According to these four parts, the correlation strength between

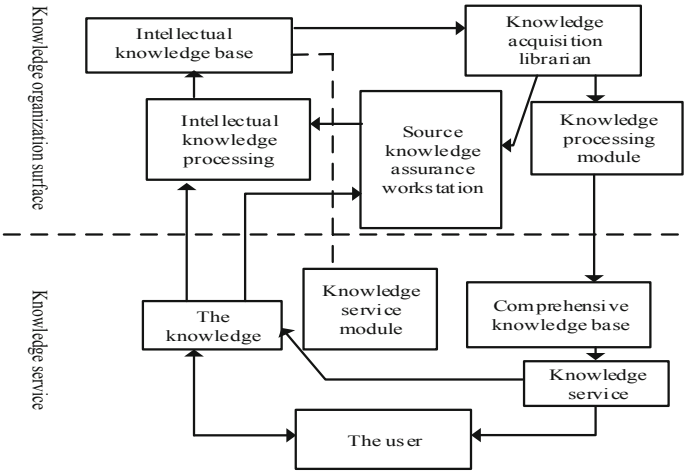


Fig. 1. Knowledge source network of online learning

the knowledge nodes of the whole network is calculated:

$$\begin{cases} C_A = \dfrac{1}{2}\displaystyle\sum_{k\in Z} CA_k h_{k-m} \\ C_V = \dfrac{1}{2}\displaystyle\sum_{k\in Z} CV_k h_{k-m} \\ C_H = \dfrac{1}{2}\displaystyle\sum_{k\in Z} CH_k h_{k-m} \\ C_D = \dfrac{1}{2}\displaystyle\sum_{k\in Z} CD_k h_{k-m} \end{cases} \tag{1}$$

Where, C stands for correlation degree, A represents intelligence knowledge base, V represents data collection set, H represents comprehensive knowledge base, D represents knowledge point inquiry, Z represents node number of knowledge points, k represents a real number set, and m represents the number of knowledge nodes with intersection. Web access process is mainly aimed at the learning interface often used by online students, that is, the access records left on the server, including frequent access paths, frequent access page groups and user clustering. Data purification processing access record, set the access record data group as, data purification processing formula

$$I = \sqrt{\sum_{n=1} (X_n - X_{n-1})^2} \tag{2}$$

Where, I represents the access data record data combination. Identify users, sessions and events in the data record, and constantly supplement path data to form the final user dialog file [1–4]. The data collection clustering algorithm is used to process the final user dialogue file p, and the correlation coefficient is calculated:

$$\rho = \frac{\sum_{p \in S} (I(p) - \bar{I})}{\sqrt{\sum_{p \in W} (I(p) - \bar{I})^2}} \tag{3}$$

Where, $\bar{I} = \frac{1}{M \times N} \sum_{p \in W} I(p)$, W and p represent the number of clustering processing, $\bar{I}$ represent the user dialog file, and represent the path data of data ρ combination. At that time, $\rho > 1$, the web access data is the knowledge of online learning. After collecting online learning data, the evaluation index of learning process is set.

2.2 Setting Evaluation Index

When setting the evaluation index, take the online learning data obtained as the processing object, divide the collected learning process data according to the technical direction and teaching design direction, and the classification types are shown in Fig. 2.

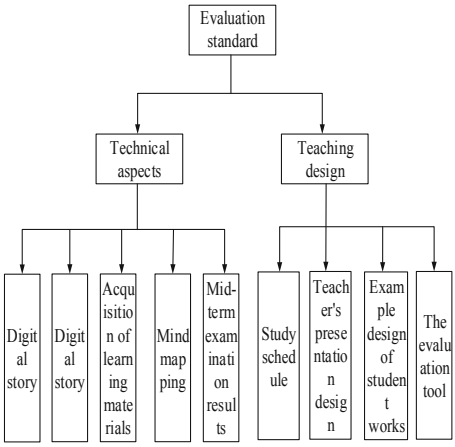


Fig. 2. Index types obtained by Division

Under the index type divided in Fig. 2, when determining the evaluation index, the appropriate value of the positive treatment index type is selected as the evaluation value of each index. In order to prevent the dimensionless value in the evaluation index from interfering with the evaluation result [5], the extreme value of the evaluation value is defined as the dimensionless value, and the extreme value calculation formula is as follows:

$$\begin{cases} x_{i\max} = \frac{\max k_i - x_i}{\max x_j} \\ x_{i\min} = \frac{x_i - \min k_i}{\max x_i - \min x_i} \end{cases} \tag{4}$$

Where, k represents the evaluation value of the index. After removing the interference of dimensionless values, the relevant parameters of the index are calculated by assuming that the random variable samples (X_1, Y_1), (X_2, Y_2), $\ldots$, (X_n, Y_n) of two indexes are

$$r(X, Y) = \frac{\sum_{i=1}^{n} (X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{n} (X_i - \overline{X})^2 (Y_i - \overline{Y})^2}} \tag{5}$$

$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$, $\overline{Y} = \frac{\sum_{i=1}^{n} Y_i}{n}$ According to the above calculation formula, the linear parameters of the evaluation index are calculated, and the correlation between the evaluation indexes is controlled [6], and the statistical quantity t of the partial linear parameters is calculated

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \tag{6}$$

The meaning of each parameter in the above calculation formula remains unchanged. When the statistics of linear parameters conform to the relationship $|t| > t(n-2)$, there is an over significance level parameter β in the linear parameter. Referring to the statistical relationship of linear parameters, the significance level parameter is calculated

$$\beta = \frac{|t|}{t(n-2)} \tag{7}$$

When the significance level parameter value β is greater than 1, it indicates that the selected evaluation parameters have strong correlation; when the significance level parameter value is greater than 0 and less than 1, it indicates that the correlation of the determination evaluation parameters is not strong [7]. When the correlation coefficient is not strong, the nonlinear parameters between the indicators are calculated. By using the Spearman correlation coefficient, the sample position $(R_i,\ L_i)$ of the evaluation index is marked, and then the nonlinear parameters can be calculated

$$\tau(R, L) = \frac{\sum_{i=1}^{n} (R_i - \overline{R})(L_i - \overline{L})}{\sqrt{\sum_{i=1}^{n} (R_i - \overline{R})^2 (L_i - \overline{L})^2}} \tag{8}$$

Where, τ is the Spearman correlation coefficient. Similarly, the position parameters conform to the quantitative relationship $\overline{R} = \frac{\sum_{i=1}^{n} R_i}{n}$, $\overline{L} = \frac{\sum_{i=1}^{n} L_i}{n}$, The statistical value of position parameter is calculated, and the significance level coefficient is obtained when the statistic formula obeys normal distribution. The index with large significance level coefficient is selected as the processing index of evaluation method, and the evaluation method is constructed by using this part of processing index.

2.3 Complete the Construction of Evaluation Method

Using the above-mentioned evaluation index as the processing object of the evaluation index, the evaluation index is divided into different evaluation systems [8], and the same grade index is regarded as a whole to allocate the weight, and the weight value can be calculated

$$\sum_{i=1}^{n} a_i = 1 \tag{9}$$

a_i represents the set of grade indicators, and the weight distribution of evaluation indicators is shown in the Fig. 3:

As shown by the numerical distribution of index weight shown in Fig. 3, the evaluation results are quantified by using fuzzy mathematics algorithm with the progressive line r of each evaluation index as the standard. It is proposed for the non-linear point of view of the evaluation process. The evaluator obtains the evaluation data of the evaluation subject from the evaluation factors affecting the evaluation subject, uses the fuzzy operation in fuzzy mathematics and other methods to quantitatively display the complex non quantitative data [9], and then makes different degrees of non quantitative fuzzy evaluation to obtain a comparable quantitative evaluation result The process and the final design of the evaluation process are shown in Fig. 4.

According to the evaluation process shown in Fig. 4, according to the evaluation objectives, the evaluation factors of the evaluation object are selected and determined, and the measurable evaluation system is established. Determine the weight of each evaluation index. Based on the importance of each evaluation factor in the whole evaluation system,

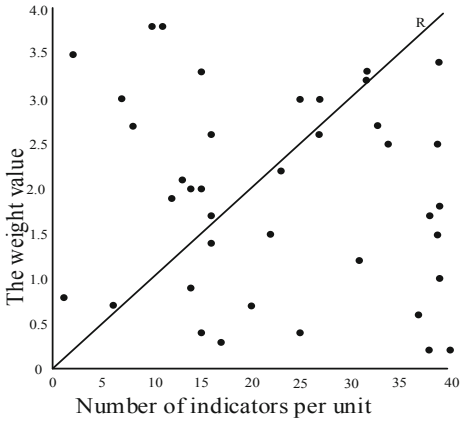


Fig. 3. Numerical distribution of index weight

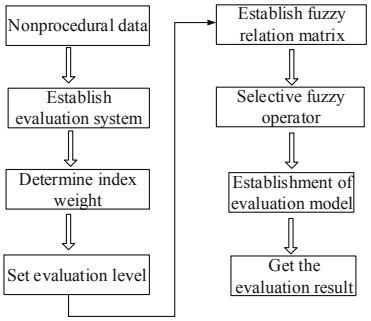


Fig. 4. Evaluation process of construction

the weight of each evaluation factor is set. Set the comment set [10]. The membership degree of each evaluation grade is determined, and the evaluation set is established, which serves as a reference and basis for the transformation of evaluation results into qualitative evaluation. The fuzzy operator is selected, the operation formula is determined, the relevant evaluation data are collected and processed, and the comprehensive evaluation results are obtained.

3 Simulation Experiment

3.1 Experimental Preparation

In the process of this experiment, the comprehensiveness of the evaluation index is taken as the experimental contrast object. The original method and the design method are applied to the experimental platform to analyze the experimental samples set in advance, and the comprehensive value of the analysis index is obtained. In order to ensure that the experimental platform has no influence on the experimental results, the parameters of the experimental platform are set as follows (Table 1).

Table 1. Experimental environment parameters

Parameter properties	Name	Parameter
Server side	Processor	Pentium 1GHz or higher
	Memory	256MB or above
	Hard disk space	40Gb or above
	Operating system	Windows 2000/Serve2003/XP
	database	MysQL 5.1
	Web server	Tomcat 5.5
	Development Kit	JDK 1.6
	Operating system	Windows 2000/Serve2003/XP
Client side	Processor	1GHz or higher
	Memory	128MB or above
	Hard disk space	10GB or above
	Operating system	Windows 2000/Serve2003/XP
	Operating system	Windows 2000/Serve2003/XP

The above parameters are used to complete the establishment of the experimental platform, and the education effect of a university is evaluated. By comparing the comprehensiveness of the two evaluation indexes, the evaluation indexes are set in the form of radar chart, as shown in Fig. 5.

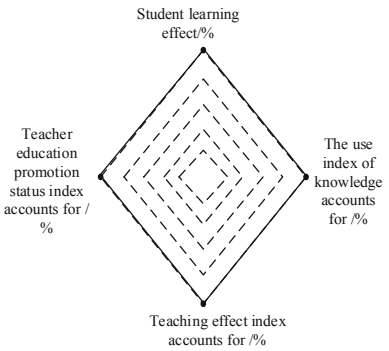


Fig. 5. Experimental sample

The experimental sample indicators are divided into four directions, namely, students' learning effect, teachers' education promotion status, knowledge use and teaching effect. In this paper, a comprehensive evaluation of the experimental results in the literature [3] was completed.

3.2 Results and Analysis

Using the above settings, the experiment was completed. The experimental results of the evaluation method in reference [3], the evaluation method in reference [6] and the experimental comparison results of the design method in the paper are as follows (Fig. 6):

According to the above experimental results, compared with the design method in this paper, the index selection range of the evaluation method in the two literatures is smaller, and the difference between the evaluation index method and the experimental sample is large. The index selection results of this design method have high similarity with experimental samples, which can effectively ensure the comprehensiveness and accuracy of the evaluation of experimental objects. The index of the evaluation method in the literature is not comprehensive, which is easy to lead to one-sided evaluation. This evaluation method can effectively avoid the problem of poor reliability of evaluation results. To sum up, the process evaluation method designed in this paper is better than the learning process evaluation method in the two literatures.

Under the above experimental environment, the multiple parameters of evaluation index in the learning process can be calculated as follows:

$$c = \varepsilon \frac{X}{r} \tag{10}$$

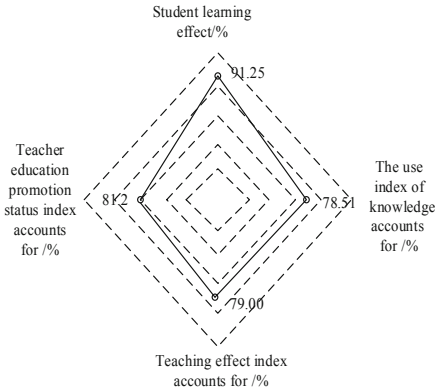
Where, represents the evaluation parameters, represents the set of evaluation factors, and represents the dimension parameters of indicators. The larger the diversity parameters obtained by defining the evaluation method, the more comprehensive the evaluation method is. Finally, the changes of diversification parameters of the three process evaluation methods are shown in Fig. 7.

It can be seen from the results of the diversification parameters shown in the above figure that with the increasing number of evaluation index sets, the three process evaluation methods show different sizes of diversified parameters. According to the size of diversification parameters obtained from the above figure, the evaluation method in reference [3] with the increasing number of sets, the value of diversification parameters obtained by this method is about 0.4 The indexes involved in the method are poor in comprehensiveness. The evaluation method in reference [6] gets about 0.7 diversification parameters, and the corresponding evaluation methods have strong comprehensiveness. However, the evaluation method designed in this paper finally obtains the diversified parameters of about 1.1, and the comprehensive index obtained by the evaluation method is the strongest.

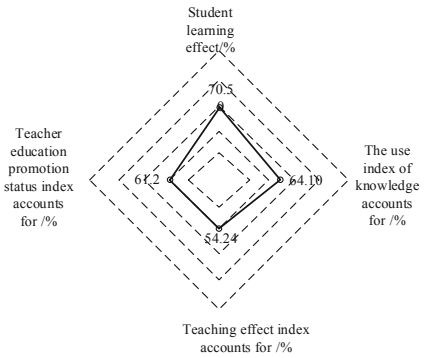
In the above experimental environment, based on the multiple parameters obtained by the evaluation method, the confidence calculation formula of the evaluation method is set, which can be expressed as follows:

$$t_r = \frac{c}{\sum_{i=1}^{k} X_i} \tag{11}$$

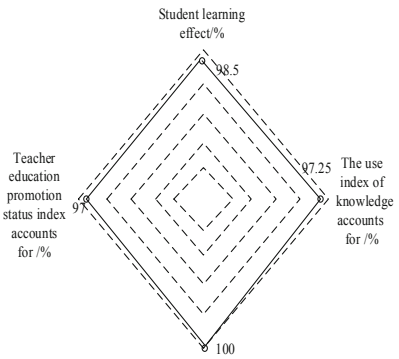
Among them, X_i represents the set of evaluation elements, k represents the total number of evaluation indicators, and the meaning of other parameters remains unchanged.



(a) Comprehensive results of evaluation methods and indicators in reference [3]



(b) Comprehensive results of evaluation methods and indicators in reference [6]



(c) The evaluation method designed in this paper has comprehensive results

Fig. 6. Comprehensive comparison results of three evaluation methods

The confidence levels of the three evaluation methods of learning process are summarized and calculated. The final confidence results are shown in Table 2.

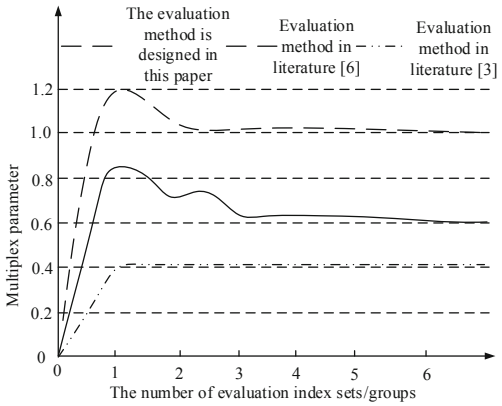


Fig. 7. Diversity results of three evaluation methods

Table 2. Confidence results of three evaluation methods

Number of indicator sets	Confidence value		
	Methods in the literature [3]	Methods in the literature [6]	The evaluation method is designed in this paper
1	4.02	7.14	9.06
2	4.09	7.35	9.23
3	4.17	7.43	9.44
4	4.28	7.62	9.48
5	4.44	7.72	9.72
6	4.62	7.74	9.87

From the confidence results shown in Table 2, the three evaluation methods show different confidence values. The larger the defined confidence value, the more accurate the evaluation results of the evaluation method. According to the values in the table, the confidence value obtained by the evaluation method in reference [3] is the smallest, and the credibility of this evaluation method is poor. The confidence value obtained by the evaluation method in reference [6] is relatively poor The evaluation method designed in this paper has the largest confidence value and the strongest credibility.

To sum up the experimental results, we can find that the designed evaluation method has a more comprehensive learning effect, up to 100%, the diversity of evaluation parameters up to 1.1, the highest confidence level up to 9.87, which has a better performance.

4 Conclusion

E-learning, born in the environment of educational informatization, has changed the traditional learning methods and learning evaluation methods. The dual process of process evaluation plays an important role in enhancing the monitoring and feedback of learners' learning process, guiding learners to maintain long-term learning motivation and improving their autonomous learning ability. Integrating process evaluation into e-learning environment and constructing e-learning platform for process evaluation is of great significance to comprehensively evaluate the learning effect and improve the quality of e-learning.However, due to the limited conditions, this paper only conducted an experiment on one university, which is not representative. In the future research, it will be further promoted, and experiments will be carried out in Colleges and universities all over the country to verify the practicability of this method.

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