Construction and practice of mixed teaching effect evaluation system in Colleges and Universities

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Abstract: with the rapid rise of blended teaching, how to measure the effect of blended teaching has become a key issue for teachers. This paper constructs a hybrid teaching effect evaluation system. Firstly, the principal component analysis is used to reduce the dimension of the existing learning data set, and the teaching effect evaluation indexes are selected. Then, the K-means cluster analysis is used to evaluate the teaching effect. The samples are divided into four categories: excellent, good, medium and poorMahalanobis classification model and Fisher criterion discrimination model put forward a joint judgment criterion to predict and classify students' final exam scores, and finally give personalized information prompts or learning warnings to different types of students. The teaching evaluation system proposed in this paper is highly targeted and can be widely used in the teaching process of College Students' performance analysis, evaluation and prediction, which has certain reference value and practical significance.

Key words: Blended teaching; K-means clustering analysis; Evaluation system

1. Research status of Blended Teaching

Blended teaching refers to the complementary advantages of online teaching and traditional teaching, forming a "Online + offline" teaching mode, which is the product of the deep integration of information technology and higher education. At present, the research on Blended Teaching at home and abroad mainly focuses on the exploration of its mode and the design of its method. Zhang Qian, Ma Xiupeng and others proposed to develop the blended teaching method of bilateral interaction, so as to encourage students to make more independent choices; Tianfupeng and Jiao Daoli explored and practiced the mixed teaching mode in Colleges and Universities under the information environment, and pointed out that the information-based teaching environment should be established from the aspects of offline classroom teaching, online teaching platform, online teaching resources, etc; Luchunyan etal. combined with the characteristics of relevant courses, emphasized that online and offline hybrid teaching should be carried out through the interactive process of teachers' guidance and students' feedback and evaluation, so as to improve students' learning ability and practical ability. Luoyinghong built a "two-dimensional Trinity" University hybrid teaching mode based on the analysis of the feedback of previous teaching modes, and deeply blended teaching concepts and information technology.

Teaching effect evaluation is an important link to measure the completion of curriculum objectives and the progress of quality improvement. Students' performance indicators can directly reflect the teaching effect. The traditional teaching evaluation method is based on the subjective evaluation of teachers, lacking other objective process evaluation indicators and the cultivation of students' cooperative ability, while blended teaching pays more attention to the process of learning. With the deepening of blended teaching, the establishment of an appropriate teaching effect evaluation system has become an important factor to promote the development of its teaching achievements. At present, the effect evaluation of blended teaching mainly adopts the questionnaire survey method or content analysis method, and the content is mainly based on theoretical elaboration, without using the students' learning effect and cognitive level to establish the teaching effect evaluation system, which is applied and tested in practice. For example, garrison and others evaluated the sense of cognitive presence based on the theory of exploratory community (COI model) and formed corresponding evaluation indicators; Li Xin proposed the theoretical basis, basic principles and construction roadmap of the flipped classroom teaching quality evaluation system by using the construction method of CDIO teaching mode evaluation system; Lichengyan etal. proposed an index system integrating pre class evaluation, in class evaluation and after class evaluation according to the tasks and objectives of the three teaching stages of flipped Classroom: pre class, in class and after class; Zhou Kaiquan built a blended learning effect evaluation system with the help of big data; Yinmaozhu made an early warning analysis of students' academic performance through big data; Yan Yan assessed learners through a questionnaire survey and found that there were obvious deficiencies in the subject, means and content of the assessment system. Wu Liangliang built a mixed teaching evaluation system from four directions: teaching support, interactive feedback, teaching effect and student satisfaction. Lifengqing and hanxiaoling built an evaluation model of "process evaluation + summative evaluation" based on the three-stage mixed teaching process of "pre class, in class and after class", and ran the evaluation system through the whole process of the classroom to enhance the reliability of teaching effect evaluation. Foreign research on teaching evaluation has also made some progress. For example, Janelle m.bailey and others adopted learner centered teaching strategies from the perspective of conceptual change with the help of cognitive reconstruction of knowledge model (crkm). The characteristics of learners and information are summarized from the characteristics of learners, information and learners' participation in information, which further shows the continuity and unity of evaluation; Afzaal ali and others evaluated the learning efficiency and teaching effect of blended teaching with the help of student satisfaction, which represents the feeling of students' expectation achievement.

2. Construction of mixed teaching effect evaluation system

In order to comprehensively evaluate the teaching effect, this paper introduces learning attitude, learning participation and learning

effect as the first level indicators. In order to facilitate quantitative calculation, the three first level indicators are further divided into five second level indicators, including course video score, assignment score, chapter learning times, number of discussions, and interim performance. Among them, the number of chapters and discussions is used to measure students' learning attitude, the score of course video is used to measure students' learning participation, and the score of homework and midterm performance are used to measure students' learning effect. First, the data is preprocessed by using exclude and my SQL software, and then the bivariate correlation analysis is carried out to determine whether there is correlation between the variables. Then the principal component regression analysis is used to reduce the dimension of the variables to eliminate the instability of the least squares estimation when the data matrix has multicollinearity. After the standardization of the original data, Select the top 4 principal components of the cumulative contribution rate to build the principal component prediction regression model of final score, scientifically evaluate students' scores, and conduct fitting analysis on the model to make the results more accurate and reliable. On the basis of the above, in order to better monitor the quality of students' online learning, the system uses the pre-processing and screening of learning records and test score data, and uses Clementine software for k-means clustering. The samples are divided into four categories: excellent, good, middle and poor. Combined with Euclid, Mahalanobis classification model and Fisher criterion discrimination model, a joint judgment criterion is proposed, The final grades are predicted and classified, and the students are given different prompts or warnings according to the classification results before the examination, so as to establish the learning evaluation and performance early warning system.

3. Application of mixed teaching effect evaluation system

This paper takes the data of two semesters of linear algebra course in a university using the online and offline mixed teaching mode as the data set, verifies the effect evaluation system proposed in this paper, and optimizes the evaluation system through the results. The specific process is as follows:

3.1 Data collection and pretreatment

Five variables, i.e. course video score V, assignment score a, chapter learning times score n, discussion score D and midterm score m, are selected as the evaluation indicators of final score Q. Pre process the data using exclude and my SQL software: ① eliminate the data depicting the same variable in the data table; ② Discard the missing variable data and its related variable data; ③ The mean standard deviation method is used to treat the data beyond the triple standard deviation as abnormal values and eliminate them; ④ The online comprehensive score table of the two semesters is associated with the final score through the student number; ⑤ Integrate the data of the second semester of 2018-2019 and the first semester of 2019-2020 after correlation.

3.2 Research on the correlation among online, mid-term and final grades

The processed data set was imported into SPSS software for bivariate analysis, and the Pearson correlation coefficient between each influencing factor and course score was obtained. See Table 1:

Table 1 three line table of correlation between online process scores and midterm and final scores

	$\bar{X}$	SD	V	N	A	D	M	Q
V course video	29.81	1.32	1					
Chapter n learning	17.56	4.33	0.215**	1				
A operation score	22.62	8.31	0.153**	0.406**	1			
D discussion score	16.75	6.89	0.160**	0.467**	0.438**	1		
M mid term exam	70.59	17.33	0.050**	0.162**	-0.02	0.141**	1	
Q final grade	67.31	17.38	0.044**	0.259**	0.199**	0.188**	0.450**	1

**At the level of 0.01 (two tailed), the correlation was significant.

According to the correlation coefficient, the correlation coefficient between the final score and the mid-term score is 0.450, indicating that there is a positive correlation between the two. The better the mid-term score, the better the final score may be. In addition, the final score is also weakly correlated with the scores of chapter learning times, discussion scores and homework scores.

In order to further verify the collinearity relationship between variables, a collinearity analysis was conducted on the five variables that affect the final grade. The kmo value was 0.6806, indicating that the correlation between independent variables was high and there was a collinearity problem. Therefore, the principal component method was used to analyze the independent variables.

3.3 Calculate comprehensive evaluation value

The eigenvalue, information contribution value and cumulative contribution rate of the principal components calculated are shown in Table 2:

Table 2 principal component analysis results

	λ	b_j	α_p	V	N	A	D	M
F_1	2.0008	0.4002	0.4002	0.2952	0.5585	0.5115	0.5561	0.1733
F_2	1.0142	0.2028	0.6030	0.0042	0.0492	-0.3557	-0.0154	0.9332
F_3	0.9098	0.1820	0.7850	-0.9486	0.0746	0.1947	0.2250	0.0783
F_4	0.5523	0.1105	0.8954	0.0877	-0.6584	0.6805	-0.1022	0.2920
F_5	0.5229	0.1046	1.0000	0.0735	-0.4965	-0.3330	0.7933	-0.0880

Select the first four indicator variables as F_1,F_2,F_3,F_4 As the principal component, it replaces the original five indicator variables:

F_1=0.2952$\tilde{v}$+0.5585$\tilde{n}$+0.5115$\tilde{a}$+0.5561$\tilde{d}$+0.1733$\tilde{m}$

F_2=0.0042$\tilde{v}$+0.0492$\tilde{n}$-0.3557$\tilde{a}$-0.0154$\tilde{d}$+0.9332$\tilde{m}$

F_3=0.9486$\tilde{v}$+0.0746$\tilde{n}$+0.1947$\tilde{a}$+0.2250$\tilde{d}$+0.0783$\tilde{m}$

F_4=0.0877$\tilde{v}$-0.6584$\tilde{n}$+0.0680$\tilde{a}$-0.1022$\tilde{d}$+0.2920$\tilde{m}$

Their cumulative contribution rate is 89.54%, achieving the purpose of data dimensionality reduction. According to the principal component coefficient, the first principal component F_1 It mainly reflects the number of times of chapter learning and discussion, which can be defined asFor online learning interaction, the second principal component mainly reflects midterm performance, the third principal component mainly reflects online browsing video information, which can be defined as online learning participation, and the fourth principal component mainly reflects homework scores, which can be defined as online learning effectiveness .

(4) Get the principal component regression equation

Using equation (8) as principal component regression analysis, the regression equation is obtained

$\hat{Q}$=0.191F_1+0.354F_2+0.200F_3+0.129F_4 (16)

The regression equation converted into standard variable is:

$\hat{Q}$=-0.121V+0.054N+0.098A+0.133D+0.417M (17)

Return to the original variable to obtain the principal component regression equation:

$\hat{Q}$=-0.23.666+1.581V+0.209N+0.209A+0.209D+0.417M (18)

(5) Fitting analysis

The MAPE of the predicted value of the total score calculated by formula (10) is 0.0261, and the prediction fitting is good. This shows that the reliability of the five variables selected in this paper is high, and the effect evaluation model can be established by using the selected evaluation index.

(6) Effect evaluation model based on K-means algorithm

According to the students' V, N, a, D, m, Q index data, K-means clustering is carried out by Clementine software. The number of clusters is 4 and the iteration is 10 times. The clustering rules are shown in Table 3:

Table 3 clustering rules for student achievement evaluation

category	1	2	3	4
Total number of categories	1462	1004	591	1069
Course video (score)	29.94	29.83	29.66	29.73
Chapter learning (points)	18.97	17.92	16.20	17.92
Operation score (points)	24.88	24.36	17.45	22.67
Discussion score (points)	18.58	17.21	14.88	14.57
Mid term examination (score)	84.13	58.62	78.96	44.52
Final score (points)	83.27	70.07	55.39	43.11
evaluation criterion	Academic excellence	Xueliang	In school	Academic difference

According to the data table of student achievement evaluation clustering rules, the overall sample is divided into four groups, representing excellent students, good students, middle students and poor students. Below we will evaluate and analyze the learning situation of these four types of students:

The top 35% of students are classified as the first group, and their scores are at the upstream level. The average scores of students at the mid-term and the end of the course are above 80, and the first four constituent indicators of their usual scores are close to full marks, which can be regarded as excellent results. There is no need to pay too much attention to the academic achievements of the group's students, which can encourage some students to expand their skills beyond their majors, and encourage them to participate in scientific research and extracurricular practice.

35% to 59% of the students are classified as the second group, and their scores are in the middle and upper reaches. Compared with the excellent students, the midterm scores of these students are significantly lower. It is speculated that these students do not pay enough attention to the early learning process, and make efforts to catch up after the midterm examination. For this kind of students, we should pay attention to their early learning and scientifically guide their learning attitude and enthusiasm.

Students from the third group are at the middle and lower levels of the team. The average final score of this kind of students is 55.39 points. It is worth noting that this kind of students have high midterm scores, even higher than the average final score of good students. It is inferred that the reason for this phenomenon may be that the learning content of the chapters after the mid-term examination is more difficult than that of the middle-term examination, and such students are more confused after the mid-term evaluation, gradually in a slack state, leading to the decline of the final grade. For this kind of students, we should pay attention to their later learning process and keep the attitude of early learning close to the students with excellent academic performance.

The students of the fourth group are in the bottom 25% of the total. Such students' academic performance is poor, their mid-term and final scores are low, and their scores are discrete. This kind of students' learning motivation is insufficient and enthusiasm is low, which is the potential object of academic early warning. For such students, their learning methods and attitudes should be corrected.

(7) Prediction of total evaluation results

The total score consists of 30% of the online score, 10% of the mid-term score and 60% of the final score. The online score is the sum of the course video score, chapter learning times score, homework score and discussion score. The prediction formula of the total score is as follows:

$$Y=0.3(V+N+A+D)+0.1M+0.6\hat{Q} \quad (19)$$

The predicted final score can be obtained by substituting the original data into formula (18), and then the predicted total score can be calculated by substituting into formula (19). Although the predicted total score is lower than the actual value as a whole, the trend of the two is roughly the same, which can reflect the relative size of the score and roughly fit the actual situation. This shows that the hybrid teaching effect evaluation system established in this paper is reliable, scientific and operable.

4. Summary

In the context of big data, an effect evaluation system using principal component analysis for dimension reduction and K-means clustering analysis for joint judgment is established, which can truly and objectively show the correlation between students' online, mid-term and final data indicators, and reasonably test the teaching effect of teachers. The evaluation system can scientifically evaluate the final score of students according to the indicators of students' learning process, and design an early warning system, so as to improve the overall learning efficiency of students.

In the future, on the premise of available data, we will deeply mine the data indicators that affect the final grade, effectively use multiple indicators to establish a more comprehensive and accurate final grade prediction model, and more accurately evaluate and predict the effect of mixed teaching. In a word, only by combining the teaching results with big data analysis can we provide a strong driving force for the effectiveness and improvement of hybrid teaching, and the effect evaluation system can also move towards informatization, standardization and long-term.

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