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Computer-Aided Design AND APPLICATIONS

Construction of Online Learning Evaluation System based on Principal Component Analysis Method

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Abstract. With the continuous development of computers, colleges and universities need to attach importance to the combination of student teaching and computer-aided design. The teaching of parametric design is used to scientifically divide different teaching contents to help students meet the needs of the digital era. Use online resources to transfer offline teaching content to online to increase offline design analysis and discussion time. Therefore, how to improve the informatization level of university education management has become one of the important challenges that Chinese education departments are facing and must solve at this stage. For computer-aided design online courses is conducive to improving the quality of online teaching of such courses. Based on the implementation process and effect analysis of computer-aided design online course teaching, the formative multiple evaluation index of course effect is proposed. Based on the potential information of multimedia, a large number of researchers have begun to conduct data mining research on it and accumulated a large amount of data. The ROF-LGB model, a comprehensive classification model based on rotating forest and LightGBM, attempts to deeply explore the potential information of the actual teaching management data set. In this process, some thoughts on educational information management are put forward for readers' reference.

Keywords: school teaching management; promotion of information technology; create and improve multimedia information technology; computer aided design course
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1 INTRODUCTION

The course of computer-aided design is based on the skillful use of software to express creative thinking, so it is very practical. Operation ability is the key to judge the mastery of the course. As a design tool, it must be combined with design thinking. It can use software driven by design

thinking to express creative images quickly. Nowadays, online learning network and mobile devices without restrictions of time and place. The traditional offline teaching education model has been greatly challenged. Junus et al. [1] has conducted computer surveys in different current curriculum fields. The result shows that among various information structures, different optional courses can cover all social information fields, which provides an online theoretical framework for computer-based teaching content. So as to help students to carry out theoretical study. The gradual popularization of online education will promote education to meet new changes. During the post-epidemic period, colleges and universities have introduced measures to popularize online teaching, which will become the norm of educational activities. Da et al. [2] has designed a teaching questionnaire similar to the online classroom. Compared with the computer-assisted questionnaire, this method has more evaluation criteria. Through the analysis of different landscape designs, the professional basic classroom comparison of the teaching rules of online teaching is carried out, and its application in different classrooms is analyzed. At the same time, the order of the rain classroom is maintained to ensure that the analysis results of different network standards under computer conditions are relatively fair. And an important skill for expressing creative ideas. The teaching effect of this course directly affects the training quality of the professional talents. Therefore, the evaluation of its online teaching effect is very important for enriching the teaching form of such courses and improving its teaching system. [3]. The online art computer-aided design course is mainly based on software teaching. Online courses have the characteristics of practicality, interactivity and practicality, which are different from the effect evaluation of ordinary online open courses. However, people are worried about the division or prejudice of MOOC against certain disciplines or countries. MOOC research is widely distributed, but has not yet fully encouraged inclusiveness [4]. Different online teaching models can be changed according to different teaching environments. Among them, the spatial structure supporting self-efficacy needs to be analyzed according to the reasonable structure. It is necessary to challenge students with high-level thinking and solve the anxiety of insufficient innovation ability through complex model tasks. Atman et al [5] analyzed the difference of scaffold types under different frame structures, and simulated the results of learning tasks. Finally, a relatively intelligent system is built. Physical education computer teaching is to carry out computer digital simulation of students under different sports conditions. By combining with teaching, we can improve teaching quality and efficiency. It can be implemented in various forms, such as virtual reality technology, electronic games, Internet resources, etc. [6]. Li et al [7] used virtual reality technology and video games to conduct intelligent exercise of sports skills, and simulated exercise of skills and actions of some sports items to improve students' skill level and reaction speed. Sports computer teaching can not only improve the efficiency and quality of sports teaching, but also make sports teaching more vivid and interesting, and stimulate students' interest and enthusiasm in learning.

2 STATE OF THE ART

Students think that the virtual laboratory is more approachable and seems to have a better grasp of the basic content than the face-to-face laboratory, although they respond to the effectiveness of online teaching with mixed results. Combining face-to-face teaching with computer-assisted, modifiable grading and evaluation procedures will help improve teaching. The current industry-recognized for "4V" (as shown in Figure 1) For the educational information management for such colleges and universities Chen et al. [8]. Although computers can help students carry out digital analysis of different software programs. However, students in digital technology need different parameters to analyze and optimize the process. Such software is also a combination of engineering technologies. At the same time, the sources of data can also become diverse, such as learning time, learning behavior, learning achievements, learning materials, etc. These data can be collected through the school's education management system, education APP and other ways. Singh et al. [9] Clean, integrate and analyze students' data to facilitate subsequent machine learning algorithm processing. Through machine learning algorithms, students' data are analyzed,

such as classification, clustering, prediction, etc., to discover students' learning characteristics and laws, and to provide teachers with auxiliary decision-making.

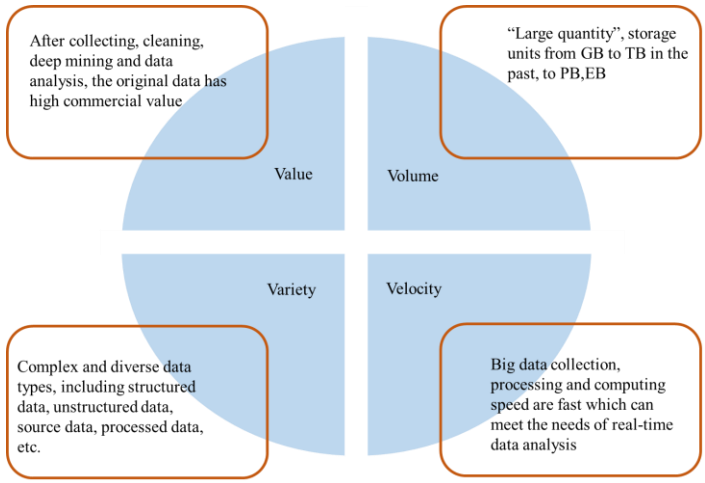

Figure 1: 4V characteristics of multimedia information technology.

2.1 Problems Existing in the Informationization of Education Management in Colleges and Universities at This Stage

Visualize students' data and conduct learning progress curve and report to improve students' learning effect and satisfaction. Students' data and machine learning algorithms based on personalized perspective are convenient for teachers and students to better understand students' learning situation and progress. At this stage, a large number of college graduates are gradually entering the university management system. Their identity has changed from manager to manager, which is a physical and psychological challenge. Most young volunteers can hardly complete their identity in a short time. At present, the overall level of information education management in China's universities is high, but there are still many problems in the details of management, which will have a negative impact on promoting the innovation of multimedia information technology education management. Education management informatization innovation education application practice standard. Implementing application standards is an effective way to standardize the use of multimedia. The innovation of multimedia information technology education needs to formulate unified and standardized practice norms according to the characteristics of multimedia information technology information application. The proposed methods and models need to be in a scientific and reasonable range. Compared with Computer Aided Instruction (CAI), Intelligent Computer Aided Instruction System is more in line with the modern education concept. Intelligent Computer Aided Instruction (ICAI) is one of the important development directions of CAI application. It provides an extremely convenient platform for people to share network resources and learn from each other [10].

2.2 Construction Process of Online Teaching Evaluation System of Computer-Aided Design

Combined with the characteristics of online course of computer-aided design, teaching should strengthen the evaluation of learning process. Determine indicators from various aspects, multiple factors and objectivity, initially establish a formative evaluation system, and develop a reasonable evaluation index framework. The first stage is to clarify the feasible objectives of formative evaluation. The online course of computer-aided design aims to help students achieve the goal of

mastering software skills. In a series of challenges in the learning process, students strive to achieve their goals and cultivate their independent learning ability and innovation awareness. In the second stage, formulate feasible and effective formative evaluation standards, and break through the traditional student evaluation based on course assignment scores. It involves the whole process of students' learning, formulates relevant standards, and regularly identifies and evaluates the acquisition of students' knowledge and skills. The third stage is to implement interactive and diversified evaluation subjects. Teachers should find problems in time, understand and guide students, and students should reflect on their own learning process.

The online course teaching of computer-aided design is the combination of recorded and broadcast courses and practical exercises. This is different in the specific teaching implementation process. It also needs to consider teaching methods, software technical support and other factors. From the perspective of teaching effect evaluation, it should include online theoretical learning and software practice.

3 METHODOLOGY

According to the characteristics of the online course of computer-aided design, formative evaluation is used to evaluate the quality and effect of the course. Formative evaluation is a dynamic and real-time evaluation, the use of reasonable information processing methods can not only effectively develop data information, but also improve the reasonable use of databases, and help management departments or managers better manage their work. This paper proposes a classification model based on rotating forest and LightGBM, and uses the ROF-LGB model to mine the data set of university teaching management to potential information in the data and evaluate the effect management system. Analyze and research the process to obtain guidance and suggestions on the actual teaching details, try to dig the potential information of the practical teaching management data set, and build the teaching relationship information system, as shown in Figure 2. In the process, several points were put forward. Some thoughts on the management of educational informatization for reference to the readers.

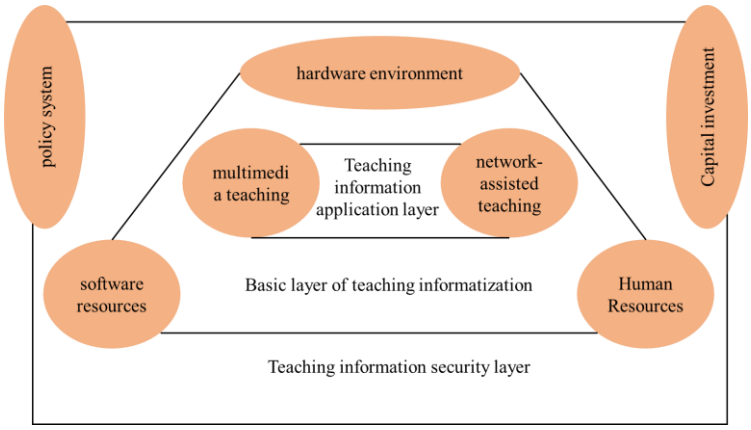

Figure 2: Teaching under the Information Structure Couple.

3.1 Rotating Forest Mode Type

Rotation forest is also a multi-classifier ensemble model based on decision tree, which has good classification performance on small and medium datasets. Both Rotational Forest and Random Forest use decision trees as base classifiers. When selecting each base classifier training sample,

the rotation forest will randomly divide the feature set, and then use PCA to perform feature transformation in each feature subset as shown in Figure 3.

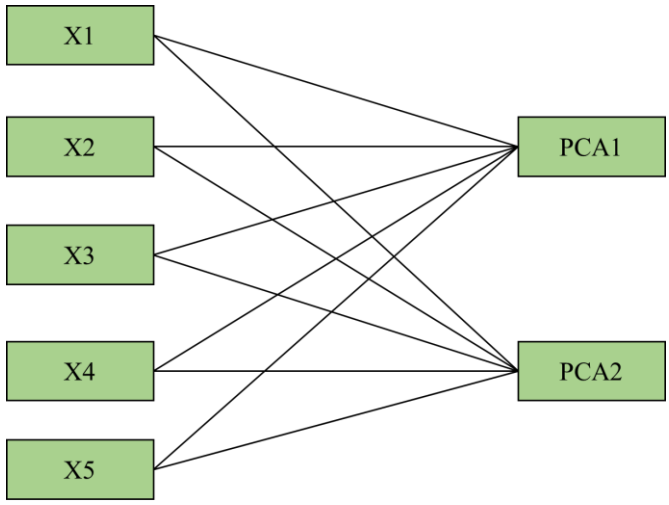

Figure 3: Principal component analysis method model.

$$\begin{cases} y_1 = u_{11}x_1 + u_{12}x_2 + \ldots + u_{1i}x_i + \ldots + u_{1p}x_p \\ y_2 = u_{21}x_1 + u_{22}x_2 + \ldots + u_{2i}x_i + \ldots + u_{2p}x_p \\ \vdots \\ y_i = u_{i1}x_1 + u_{i2}x_2 + \ldots + u_{ii}x_i + \ldots + u_{ip}x_p \\ \vdots \\ y_p = u_{p1}x_1 + u_{p2}x_2 + \ldots + u_{pi}x_i + \ldots + u_{pp}x_p \end{cases} \tag{3.1}$$

After the model is changed to matrix form, it is shown in formula (3.2):

$$y = \begin{bmatrix} u_{11} & u_{12} & \cdots & u_{1p} \\ u_{21} & u_{22} & \cdots & u_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ u_{p1} & u_{p2} & \cdots & u_{pp} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_p \end{bmatrix} = Ux \tag{3.2}$$

$$u_{i1}^2 + u_{i2}^2 + \cdots + u_{ip}^2 = 1 \tag{3.3}$$

Assuming that x represents a piece of n-dimensional sample data, a matrix X is used to represent the training sample set containing all N pieces of sample data. Suppose Y is a vector containing all sample labels, where y represents a certain class of labels corresponding to the sample label set. Use D to represent each base classifier (divided into L base classifiers in total), and use F to represent the feature set. The algorithm flow of the rotating forest is as follows:

(1) Randomly divide the feature set F into K subsets, and generally select disjoint subsets. For simplicity, assume that K is a factor of n, such that each sub-feature set contains features that can be expressed as:

$$M = \frac{n}{K} \tag{3.4}$$

(2) For each sub-feature set F, 75% of the original sample set is randomly resampled, and PCA is used to perform principal component analysis on only the M features in F in the new sampling set obtained. The purpose of performing PCA on each sub-feature set rather than the overall dataset is to make the training data coefficients used by each base classifier different, thus increasing the variability among the classifiers.

(3) Put all the obtained principal component coefficient vectors into a sparse rotation matrix R:

$$R_i = \begin{bmatrix} a_{i,1}^{(1)}, a_{i,1}^{(2)} \cdots a_{i,1}^{(M_1)} & [0] & \cdots & [0] \\ [0] & a_{i,2}^{(1)}, a_{i,2}^{(2)} \cdots a_{i,2}^{(M_2)} & \cdots & [0] \\ \cdots & \cdots & \cdots & \cdots \\ [0] & [0] & \cdots & a_{i,K}^{(1)}, a_{i,K}^{(2)} \cdots a_{i,K}^{(M_K)} \end{bmatrix} \tag{3.5}$$

Compute the confidence that x belongs to each class:

$$\mu_j(x) = \frac{1}{L} \sum_{i=1}^{L} d_{i,j}(xR_i^a), j = 1, 2 \cdots, c \tag{3.6}$$

The last step is to compare the confidence of each category, and the category with the largest confidence determines the category to which x finally belongs. The algorithm flow chart is shown in Figure 4.

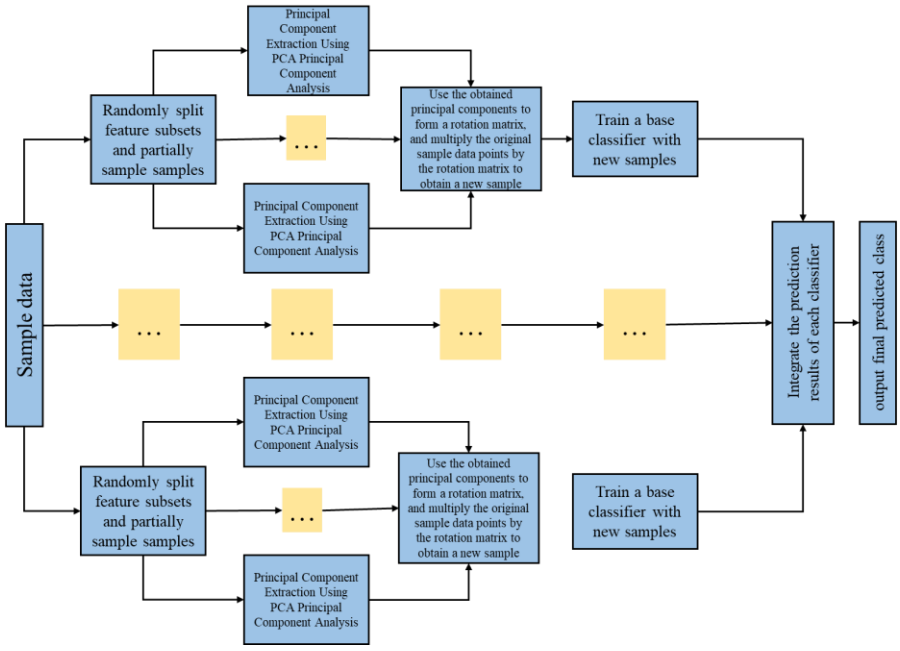

Figure 4: Flowchart of the rotating forest algorithm.

When the traditional GBDT algorithm builds a decision tree, the Presorted algorithm is used to find the optimal split point. For each feature, all data samples must be traversed to calculate the information gain of all possible split points. As shown in Figure 5, LightGBM adopts an improved Histogram algorithm, which divides the continuous floating-point eigenvalues into k intervals. It

only needs to select the optimal segmentation point in these k intervals, which greatly improves the training speed and space utilization. efficiency.

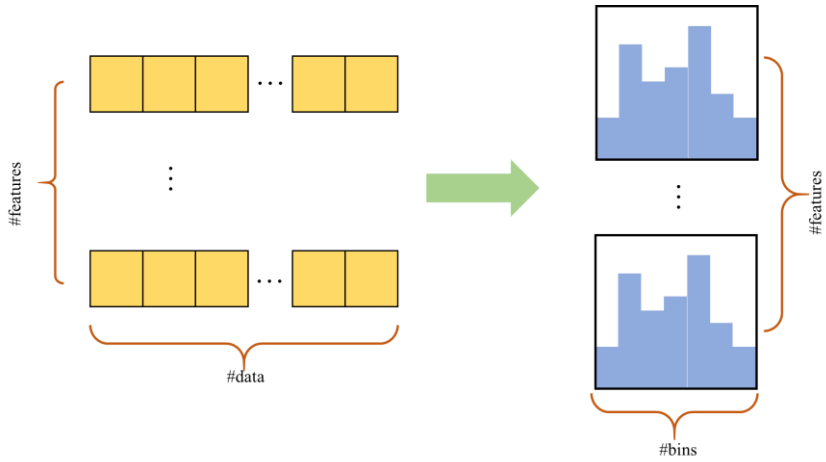

Figure 5: Schematic diagram of histogram algorithm.

3.2 Combining Classifier with Rotation Forest and LightGBM

The tree itself has a simple structure and limited classification accuracy. This paper proposes a combined classifier combining Rotation Forest and LightGBM, referred to as the ROF-LGB model. In this model, the decision tree algorithm of the base classifier is replaced by the LightGBM algorithm. Compared with other GBDT algorithms, the calculation speed of LightGBM has obvious advantages. Compared with the simple decision tree algorithm, the calculation speed has disadvantages, but the classification accuracy is greatly improved.

In the original rotating forest algorithm, the decision tree is selected as the base classifier because the decision tree is very sensitive to the rotation of the feature axis, and the underlying classifier of LightGBM itself is also a decision tree algorithm, which is also consistent with the original rotating forest model idea. The overall model leverages the excellent performance of Rotation Forest on classification accuracy of LightGBM, providing an option to pursue higher accuracy on small and medium-sized datasets. In the part involving the rotation forest, the variable parameters that mainly affect the performance. In the part involving LightGBM, the tunable parameters are the same as LightGBM.

Classification models can be divided into two categories according to the number of labels (categories) in the training dataset: binary classification models and multi-classification models. In fact, the basic principle of many classification algorithms is designed for the two-class problem, and then the solution adopted, and you can use the accuracy, precision, and recall rate. and weighted harmonic mean to measure the effect of the model.

4 RESULT ANALYSIS AND DISCUSSION

4.1 Experimental Research Object

The research data of this paper adopts the teaching management data set of a university. The data set has 49 characteristics, 42 of which are the results of the university teaching management training program, and the other 7 are students' gender, race, age, class, source and class. GPA and whether there are failed classes. Among them, the large class has 5 characteristics, the middle

class has 15 characteristics, and the small class has 22 characteristics. In the experiment, we can use the characteristics of large, medium and small categories to analyze the data, so as to find the reasonable degree of this classification and the relationship between large and small categories. This course attempts to use traditional blackboard teaching theory in classroom teaching, supplemented by Mtalab software simulation. On this basis, the teaching method of actual case analysis is interspersed to make the teaching content intuitive and understandable. At present, the university information application system has covered teaching, scientific research, management and other school main businesses. Official data show that the overall level of informatization in 117 universities has improved. The survey results are shown in Figure 6.

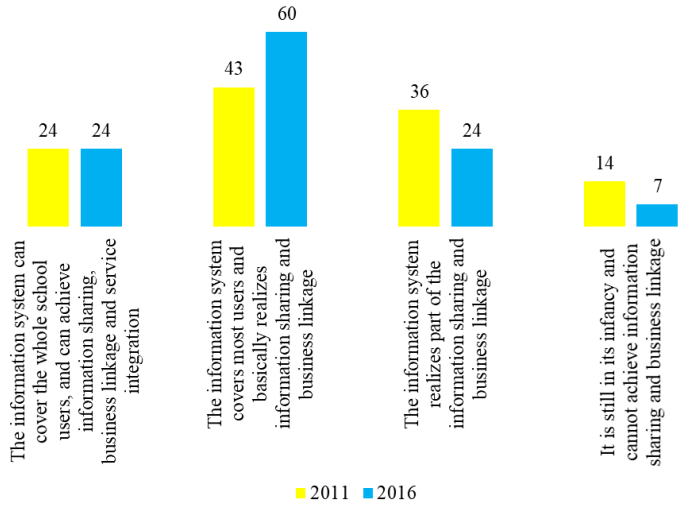

Figure 6: Specific application of university information system.

The serve teachers and students, alumni, faculties, management departments, etc." has increased from 43 in 2011 to 60 in 2016. Correspondingly, the number of colleges and universities is still in its infancy There are fewer and fewer colleges and universities, from 14 in 2011 to 7 in 2016. The information application system includes teaching management system, educational affairs management system.

The survey results on the use of the above information management systems are shown in Figure 7. The schools that integrate the teaching and educational information system, OA system and financial management system are the most, and all have developed greatly, from 60% in 2011 (77/78/68), rising to over 70% in 2016 (98/97/87).

Among the 117 colleges and universities surveyed, the number of schools that have established a campus public database or data exchange system has increased. In terms of establishing a campus public database or data exchange system, 985/211 colleges and universities are significantly better than general full-time undergraduate colleges and higher vocational colleges. Specialize. This is also closely related to the complex data exchange requirements of 985/211 universities. However, the work in this area is still hindered by problems such as system construction in actual operation. In the future, colleges and universities will further explore and improve the management system. In a school that has established a campus public database or data exchange system, its data categories include student information, faculty information, scientific research project information, and public resource information as shown in Figure 8. There is still room for improvement in the information exchange of public resources and scientific research projects.

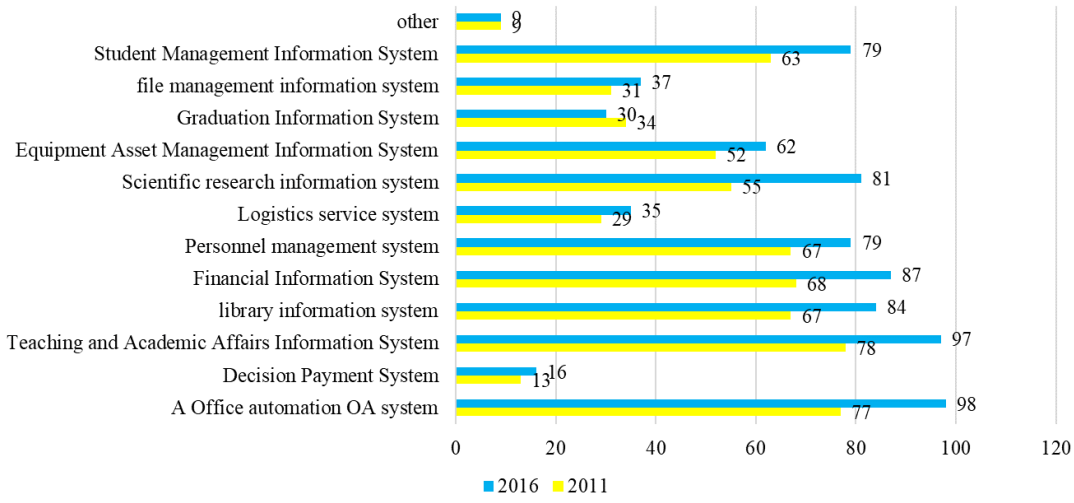

Figure 7: Comparison of service systems integrated by university information portals.

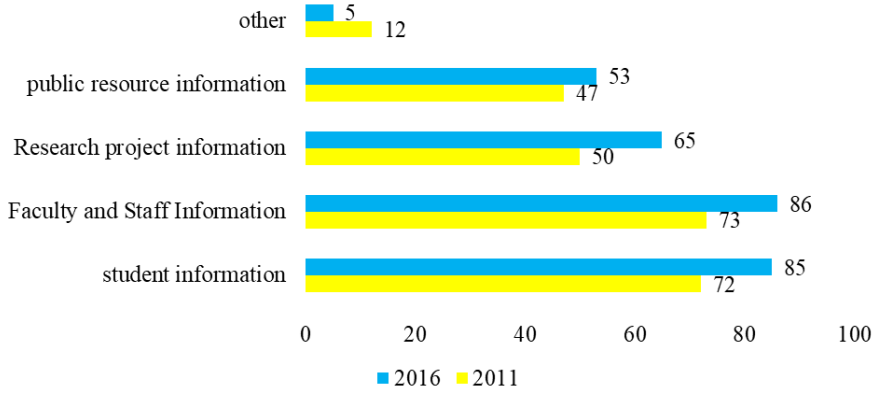

Figure 8: Comparison of data types in university public databases or data exchange packages.

Colleges and universities, as the main front of Chinese talent training, is imperative to promote education informatization. According to the designed algorithm, the importance of various factors involved in the teaching management of colleges and universities is measured. Experiments are conducted using a dataset composed of class features in teaching administration. The features of this dataset consist of 22 features in 15 categories of teaching management results and 7 other basic information.

Taking the data of the past six semesters as an example, among all teaching courses in the school, the development rate of informatization teaching in the past two years has remained at about 64%. The data shows that while the number of school courses has increased, the development rate of informatization teaching has increased, and the pass rate of informatization teaching courses has also increased, but the increase is not large, while the excellent rate of informatization teaching courses has hardly increased. See Figure 9 for details.

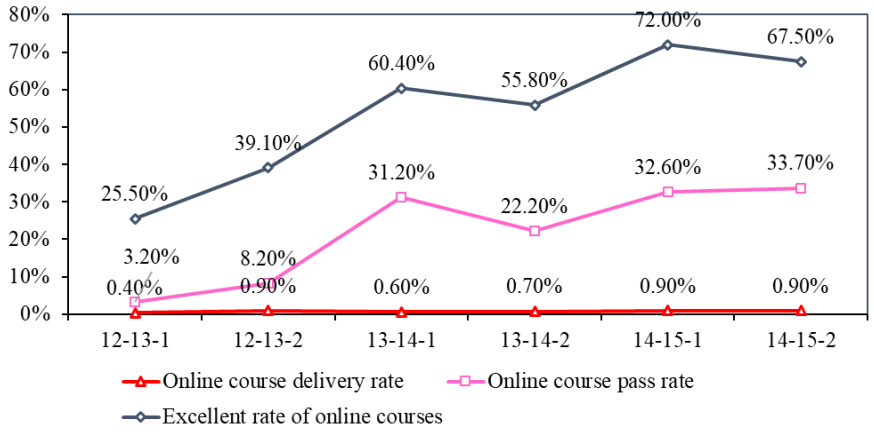

Figure 9: The situation of the school's informatization teaching courses in the past six semesters.

The development rate of network assisted teaching courses in the college varies greatly. See Figure 10 for some colleges. The average development rate of 83% of the school of Materials Science and Engineering with the highest development rate in the sixth semester, and that of Art and Design with the lowest sixth semester average development rate was only 20%. The average qualified rate of the School of Marxism was 43.8%, and the School of Art and Design was only 5.6%. The school is the School of Materials Science and Engineering and the School of Marxism. This is due to the great disparity of teachers' enthusiasm to use network-assisted teaching, and the colleges of active and handy teachers are relatively concentrated.

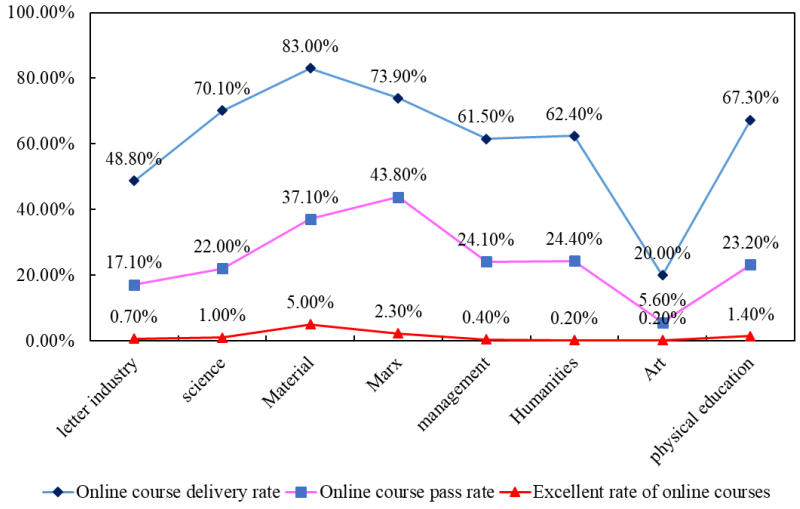

Figure 10: Online-assisted teaching courses in some colleges in the past six semesters.

In the middle and end of the semester, the online teaching platform visits showed a peak trend, with the smallest number of visitors in winter and summer vacation. On the teaching platform, 74.21% of the courses with course introduction, teaching syllabus and teaching calendar accounted for 74.21% of the total number of online assisted teaching courses, 66.64% of the courses were

equipped with relevant teaching materials, and only 25.10% of the courses for answering questions and discussion.

5 CONCLUSION

In view of the practical characteristics of the online course of computer-aided design, this paper insists on focusing on the process indicators in the process of establishing the course evaluation index system. It not only considers the developmental evaluation indicators in teaching conditions, but also the process evaluation and effect evaluation indicators. The construction of curriculum formative index evaluation system will help to fully grasp the learning track of students in teaching activities. It mainly expounds the specific research. The comprehensive classification model ROF-LGB model attempts to deeply explore the potential information of the actual teaching management data set. Finally, the paper puts forward some suggestions and strategies for the informatization of school teaching management under the multimedia information technology environment, aiming at providing a new model for school teaching management. By optimizing the traditional evaluation indicators, we have made improvements in the aspects of curriculum characteristics, curriculum process, multiple curriculum assessment, etc., and improved the enthusiasm of students and curriculum effect. Formative multiple evaluation is an effective means to evaluate the effect of online teaching of computer-aided design, and it provides help for the construction and content improvement of online course of computer-aided design.

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