Construction and Practice of Mixed Teaching Mode of Chemistry in Colleges and Universities Based on Big Data Analysis

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Abstract. The single online teaching lacks the analysis and processing of a large number of students' complex learning behavior data, so that the evaluation of learning effect is scientific and operability. In this regard, this paper takes the chemistry major in colleges and universities as the research object, and with the help of the characteristics of big data analysis technology and computer software application technology, completes the function optimization of network teaching platform and improves the teaching effect of mixed teaching mode. The online teaching platform of chemistry course belongs to B/S architecture. The front-end interactive interface is designed by React framework, and the back-end server is built by Django framework. For the analysis and processing of students' learning behavior data, we need to use Pandas, NumPy, Matplotlib and other class libraries in Python language to complete data preprocessing, analysis model construction and data visualization in turn. After simulation test, the platform can combine the process evaluation with the traditional summative evaluation, make up for the shortcomings of online teaching, and promote the application of mixed teaching mode in college chemistry teaching practice.

Keywords: Big data analysis · Chemistry · Mixed teaching mode · Python · Computer software application

1 Introduction

With the deepening of social informatization, the integration process of a new generation of digital information technology and education and teaching innovation, represented by big data and cloud computing, is accelerating from single factor to deep breakthrough development [1]. As an inevitable way for the development of China's education modernization in the new era, educational informatization can form a mixed teaching ecology combining traditional physical classroom and online teaching, and promote the systematic reform of teaching mode. However, the implementation of online teaching needs to be realized by Web application or mobile APP. Teachers and students are relatively independent in the whole learning process, so that there is no corresponding supervision and management and evaluation of learning effect, which affects the effectiveness of

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mixed teaching mod [2]. In view of this, this paper believes that colleges and universities should change their teaching concepts, adhere to innovation-driven, and put forward an optimization scheme of network teaching platform in view of the problems faced in the daily teaching activities of chemistry majors. It aims to use the practical advantages of big data analysis technology and computer software application technology to analyze and process the massive, complex and diverse learning behavior data left on the teaching platform, intuitively reflect the whole process of online teaching, and complete the assessment and evaluation of online teaching effect on this basis, providing necessary guarantee and support for the construction and application of mixed teaching mode for chemistry majors [3].

2 Development Process

The overall development of the network teaching platform for chemistry majors in colleges and universities includes two modules: functional structure design and basic framework construction. The functional structure of the platform can be divided into four parts from top to bottom: client, content layer, service layer and data layer [4]. For the basic framework, the building process consists of front-end interactive pages and back-end servers. The front-end interactive page is mainly designed and developed with React framework [5]. The development and deployment of the back-end server need to be realized with the help of the Django framework of "request/response" mode, and follow the MVC design pattern, so that the front-end interactive interface and the back-end server can be associated and connected under a specific data interface [6]. The basic development environment consists of operating system Linux CentOS 7.3, development language Python 3.8, integrated development tool Pycharm 2019, database server Mysql 5.7.31 and Nginx-WSGI-Django Web server module. When the functional modules are designed, all the files are packaged and published on the server, which is convenient for users to log in and visit remotely. Through the introduction of the above key technical theories, the overall environment of system development, the configuration of related software and tools are determined, and the technical feasibility of the overall project of network teaching platform for chemistry majors in colleges and universities is also clarified.

3 Functional Implementation

3.1 Student Side

Under the platform, student users can log in to the system before class and preview the course. According to the chapter system of chemistry major courses, teachers will publish the relevant documents, teaching points, teaching objectives and other contents on the platform in advance, which will help the subsequent classroom teaching. In particular, chemistry courses contain a lot of experimental teaching. Preview in advance can strengthen students' mastery of experimental methods, experimental equipment, experimental materials, experimental principles and other knowledge, and make classroom teaching content more focused on practical operation, thus improving the effectiveness of course teaching [7].

Under the platform, student users can check the homework published by teachers in time, and complete the online editing and submission of experimental reports with the help of the open window of the system. For extended discussion, student users can form groups with their classmates and finish them together. In addition, the platform will also provide some test question banks, which is convenient for students and users to conduct self-test exercises online.

The platform will also make use of the advantages of network information technology to facilitate communication between students and between teachers and students. On the one hand, it is helpful for students to get targeted guidance from teachers, on the other hand, it is also helpful for teachers to grasp the actual situation of students in time.

3.2 Teacher Side

In the mixed teaching mode, the role orientation of teachers is biased towards the organizers and managers of teaching practice [8]. Teachers will focus on the evaluation of students' learning effect. In the process of assessment, the platform will automatically obtain the CSV file of student users' operation logs, and effectively extract the students' learning behavior characteristic data through data preprocessing. The behavioral characteristics, classroom grades and final grades are simultaneously input into the K-means clustering analysis and Pearson correlation analysis algorithm model to complete the evaluation of learning effect.

In Python environment, the platform can automatically call the cluster in sklearn class library to obtain the sum of squares of errors (SSE) under different K values. As shown in Formula 1, where C stands for category, p stands for data value, and m stands for centroid [9]. As shown in Table 1, the K values corresponding to each characteristic field are detailed. Then, the corresponding data values and K values of the characteristic fields are input into the K-means clustering analysis model to get the clustering analysis results of each characteristic field with the usual grades and final grades. As shown in Fig. 1, it is a cluster analysis diagram of the test scores of question bank and final scores, in which the abscissa is the test scores of question bank and the ordinate is the final scores.

$$SSE = \sum_{i=1}^{k} \sum_{p \in C_i} |p - m_i|^2 \tag{1}$$

Table 1. Teaching effect evaluation system

No.	Feature field	K value
1	Login time	3
2	Cumulative use time	4
3	Preparation completion degree	2
…	…	…

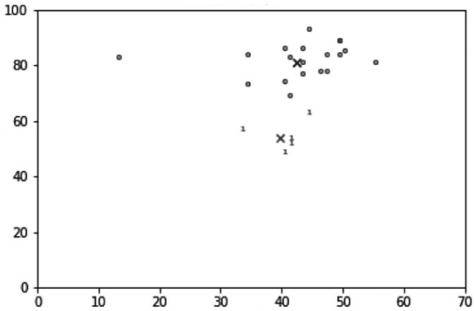

Fig. 1. Cluster analysis result diagram

Table 2. Teaching effect evaluation results

No.	Feature field	Pearson correlation coefficient
1	Login time	−0.0215
2	Cumulative use time	0.0134
3	Preparation completion degree	0.4825
…	…	…

Under the Pearson correlation analysis algorithm model, the correlation between various characteristics and grades can be further clarified. Take each characteristic field as set A, and the usual grade or final grade as set B. The calculation results of Pearson correlation coefficient are shown in Table 2. According to the calculation of K-means clustering and Pearson correlation analysis model, students' learning effect under mixed mode can be evaluated from multiple dimensions, which corrects the one-sidedness of traditional evaluation methods, and then clarifies the influence degree of various characteristics on grades, which provides a basis for improving the effectiveness of chemistry teaching [10].

4 Conclusions

In order to improve the teaching effectiveness of chemistry major in colleges and universities under the mixed teaching mode, this paper puts forward a set of functional optimization scheme of network teaching platform to solve the problem of insufficient evaluation of learning effect. The platform can integrate data analysis technology into the teaching evaluation process, highlight the value and significance of students' online learning behavior data, effectively promote the organic combination of online teaching and classroom teaching, and accelerate the process of teaching mode innovation and reform. In the follow-up research, the system should further enrich the construction of teaching resources, optimize the application ability of data analysis module, and provide reference for the informationization and intelligent development of higher education.

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