# Construction and Optimization of University Teaching Management System Based on Data Mining Technology

MeiLin Jin(✉)

Wenzhou Vocational College of Science and Technology, Wenzhou 325006, China

**Abstract.** As an important part of education informatization, the university teaching management system collects a lot of teaching information, but most of them have not been well mined and studied, so the application of data mining in the university teaching management system has practical significance. This paper introduces the basic principle of data mining technology and the method to solve the problem, and discusses a method of combining data mining technology with teaching management system in Colleges and universities, which improves the work efficiency of teaching management in Colleges and universities, realizes the rationality of teaching resource arrangement, and makes a new exploration in the construction of teaching informatization in Colleges and universities.

**Keywords:** Teaching management · Data mining · Association rules · Decision tree

## 1 Introduction

In recent years, with the rapid development of computer technology and network technology, the teaching information management system of colleges and universities has been greatly developed and widely used. At present, domestic colleges and universities have been equipped with information-based teaching management systems to varying degrees. Most of these teaching management systems use database technology and network communication technology, and basically include student management, teacher management, curriculum management, performance management and other functional modules [1].

In the teaching management system, a large number of records and data generated in the teaching process are stored and managed in the database, which improves the shortcomings of the traditional paper recording method, such as easy to lose, easy to damage and inconvenient to consult. At the same time, the paper is saved, which can improve the management efficiency and achieve economic and environmental protection. On the other hand, the application of network technology in the teaching management system, So that the transmission, processing and inquiry of teaching information can be completed remotely, and the flexibility of teaching management is improved. The emergence

© ICST Institute for Computer Sciences, Social Informatics and Telecommunications Engineering 2021
Published by Springer Nature Switzerland AG 2021. All Rights Reserved
M. A. Jan and F. Khan (Eds.): BigIoT-EDU 2021, LNICST 391, pp. 448–458, 2021.
https://doi.org/10.1007/978-3-030-87900-6_52

of information-based teaching management system provides great convenience for the teaching management of colleges and universities, improves the operation efficiency of the management of colleges and universities, and reduces the cost of running a school.

However, in the application process of teaching management system, the system will save a large amount of data, such as the basic information of students and teachers, students' scores and so on. If it can't be used effectively and organically, these massive data are simply stored in the database of the management system, which will probably turn the massive data into useless garbage, that is to say, the phenomenon of "data explosion and lack of knowledge" is caused. In fact, there are some potential connections and objective laws between these massive data. Finding and using these connections and laws effectively will be of great help to the analysis and evaluation of teaching quality and the decision support of university management, so as to make the teaching management system play a greater role. Data mining technology is a kind of technology to analyze the relationship and law hidden in massive data, and obtain useful information from it.

## 2 Overview of Data Mining Technology

### 2.1 The Concept of Data Mining

With the rapid development and wide application of information technology, database systems in all walks of life save and manage a large amount of data, but most of the database systems can only provide some simple data management and processing functions. On the other hand, with the development of society, the importance of data has become increasingly significant, and people's demand for data analysis and processing has become increasingly strong, which is difficult to achieve by using the traditional, manual data analysis methods and database system. With the explosive growth of data in various industries, the phenomenon of "data explosion and knowledge poverty" is becoming more and more serious. Therefore, in the face of massive data, people are eager to have a scientific and systematic technology that can be used to analyze and process these data, so as to find the valuable information contained in the massive data to serve for decision-making [2].

Data mining refers to the process of analyzing and extracting the knowledge that people are interested in from massive data or database. These knowledge are some potentially valuable information, which can exist in the form of concepts, rules, regulations, patterns, etc. For data mining, another authoritative definition is: data mining refers to the process of extracting hidden, unknown, but potentially useful information and knowledge from a large number of, incomplete, noisy, fuzzy and random practical application data.

Generally speaking, data mining is the process of analyzing massive data and mining knowledge from it. "Mining" vividly represents the process of finding useful and high value data from a large number of unprocessed and low value data. "Knowledge" refers to concepts, rules, rules and patterns, that is, valuable and interesting information extracted from massive and complex data. These "knowledge" can be used to discover data rules, provide decision support, and data mining technology is an effective means to achieve this process.

### 2.2 Assessment of Students' Academic Performance

In the teaching management of colleges and universities, students' academic performance is also an important index to evaluate the level of running a school and the quality of teaching. However, most of the existing performance evaluation methods are simple manual calculation, which is difficult to make a comprehensive and comprehensive analysis of the performance data. Data mining methods, such as classification based on decision tree, can be used to mine useful information from performance data, so as to provide effective decision support for school managers and improve the level of running a university.

Teacher information management
The staff of educational administration manage the information of teachers through this module, including the addition, modification, deletion, query and so on. When adding information, open a new window to record the teacher's information. When saving, check whether the teacher's number is repeated. If the added teacher's number is repeated, prompt the user. Only when it is not repeated can the information be added. When deleting information, you should first open the prompt window to let the user confirm whether to delete. Only after the user confirms can you delete the information. When modifying the information, you should be able to modify according to the teacher item selected by the user, that is, list all the information of the teacher selected by the user, and modify the teacher information on this basis.

Class information management
Through this module, the educational administration staff manage the information of the class, including the addition, modification, deletion and query of the class information. When adding information, open a new window to input class information. When saving, check whether the class number is repeated. If the added class number is repeated, prompt the user. Only when the information is not repeated, can the information be added. When deleting the information, the user can check whether the class number is repeated, First, pop up a prompt window to let the user confirm whether to delete. Only after the user confirms can the information be deleted. When modifying the information, it should be able to modify according to the class selected by the user, that is, list all the information of the class selected by the user, and modify the class information on this basis (Such as the class management in the fortress).

Student information management
Educational administrators manage student information through student information management module, such as adding, modifying, deleting and querying student information. When adding information, first enter the student information in the new window. When saving, check whether the student number is repeated. If the added student number is repeated, prompt the user. Information can only be added without repetition. When deleting information, you should first open the prompt window to let the user confirm whether to delete. Only when the user confirms can you delete the information. When the information is modified, it should be modified according to the students selected by the user, that is, all the information of the students selected by the user is listed, and the student information is modified on this basis.

Course information management
The educational administration staff manage the basic information of the course through this module, including the addition, modification, deletion of the course information and the setting of the class course. When adding information, open a new window to input information. When saving, check whether the course number is repeated. If the added course number is repeated, prompt the user. Only when it is not repeated can information be added. When you delete information, you should first open a window to let the user confirm whether you want to delete it. You can only delete it after it is confirmed. When the information is modified, it should be modified according to the course selected by the user, that is, the information of the course selected by the user is listed, and the course information is modified on this basis.

Achievement information management
The staff of educational administration manage the students' grades through this module. When adding the students' grades, it can be used to set the curriculum of the class for the students and input the grades directly.

Financial information management
Through this module, educational administration staff manage financial information, including students' payment and arrears. When paying, open a new window to input the payment. When saving, check the database to see whether the students have paid the fees. Payment can only be made without repetition. In the case of students in arrears, you can find out some classes of students in arrears, and you can export Excel to print (Such as the financial payment in the college school connection).

Printing information management
The staff of educational administration can print the student's score information, course selection record table and class table through the printing module. According to the class, student number, course number to print student transcripts, print before you can preview the report to be printed.

Comprehensive information query
Through this module, we can query all kinds of information needed by educational administration. For example: student information query provides information such as student number, name, class, head teacher's name and dormitory, and various query conditions for student information query. Users can query according to a single query condition or their combination. At the same time, it also provides the function of fuzzy query, that is, the module can use the reader's input incomplete query conditions to query, which is more convenient for the user's query management. The comprehensive query module includes student information query, teacher information query, class information query, department information query, course information query and score query.

System management
The module can manage the login users. In this module, educational administrators can add the list of persons allowed to log in and the corresponding password, and modify or delete the password of existing users.

### 2.3 ID3 Algorithm

ID3 algorithm was put forward in 1986, the core idea of the algorithm is: using information gain as the selection criteria of attributes, selecting attributes for all levels of nodes in the decision tree, so that the maximum category information can be obtained at all levels of nodes [3]. The specific process of the algorithm is as follows: first, all the attributes of the data item are traversed by width first, and the attribute with the largest information gain is selected as the node of the decision tree; then, starting from the node, the branches of the node are established according to the different values of the attributes; then, the branches of each branch are established by recursive method; finally, when all the subsets only contain the same type of data, the, At the end of the algorithm, the decision tree is obtained. The information gain of the attribute is calculated as follows:

Then the entropy of a given sample classification is as follows:

$$I = \sum_{i=1}^{m} p_i \log_2 p_i \tag{1}$$

So the entropy of a subset:

$$IYA = a_j Y = \sum_{i=1}^{m} p_{ij} \log_2 p_{ij} \tag{2}$$

ID3 algorithm has the advantages of simple principle, easy implementation and strong training ability: it is sensitive to noise, and the result is stable only when the data set is small; when the data set is large, the result of decision tree obtained by ID3 algorithm is not stable.

## 3 Methods of Data Mining in Teaching Management

### 3.1 Clarify Management and Decision Making Issues

This paper summarizes and identifies the management and decision-making problems of education and teaching, determines the management and decision-making objectives to be achieved, and then transforms the management and decision-making objectives into data mining objectives, and defines them. The data mining process is shown in Fig. 1.

### 3.2 Extraction, Analysis and Preprocessing of Original Data

After the data mining task is customized according to the requirements of management and decision-making objectives, the data is extracted from the teaching management information system and other related functional management databases to eliminate the interference of noise data, vacancy data and inconsistent data, and the obtained data is cleaned up, integrated and transformed [4].

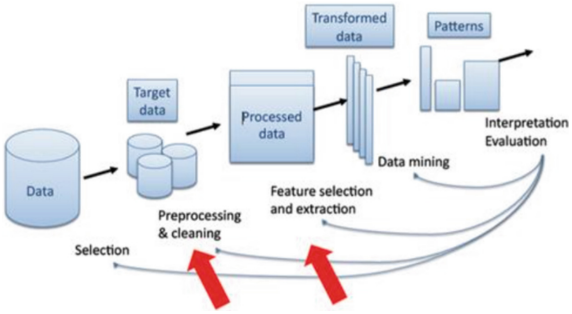


**Fig. 1.** The data mining process

### 3.3 Design and Use Data Mining Algorithm

According to different predetermined goals and data mining tasks, design a variety of data algorithms to determine effective data processing models and patterns [5].

The main problem of university teaching management data mining is to apply the new computer data mining technology to university teaching management through research, exploration and practice, and promote the university teaching management information to a higher level. Through the micro, meso and macro statistical analysis, synthesis and reasoning of teaching management data, we can find the relevance, change trend and general knowledge among all kinds of teaching activity data. With the knowledge obtained from the re development of these information to guide the teaching management and decision-making activities in Colleges and universities, we can manage and make decisions more scientifically and reasonably, It is conducive to the orderly and normal teaching activities [6].

### 3.4 Refine Data and Mining Results

The data of teaching management database is huge. The data obtained after preprocessing and value measurement screening operation and the corresponding mining mode designed based on this data should be adjusted circularly according to the needs of teaching management, and the data processing mode with the most practical application value should be determined, In the form of data analysis report, it provides decision support knowledge for the teaching management departments and school leaders [7].

### 3.5 Data Mining Results Simulation

We use the data mining structure in Fig. 2. Each structure contains different functions, that is, each structure contains different function nodes [8]. The specific simulation is shown in Fig. 3.

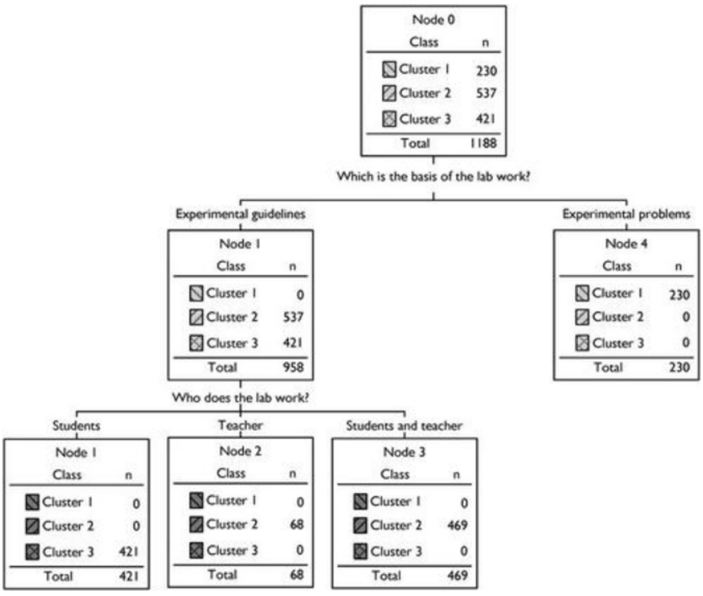


**Fig. 2.** Simulation structure for data mining

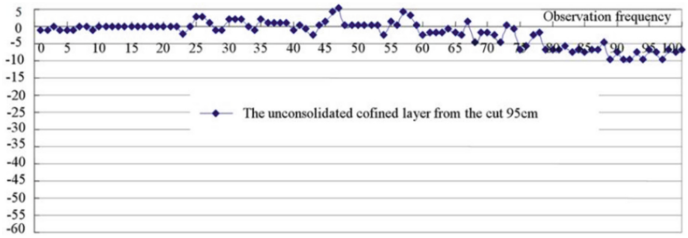


**Fig. 3.** Results of simulation

## 4 Application of Data Mining in Teaching Quality Monitoring and Evaluation System in Colleges and Universities

### 4.1 Determination of Data Mining Target

In order to meet the long-term development of the country, the enrollment scale of colleges and universities is expanding year by year, and the education methods are flexible and diverse. Most colleges and universities are facing the contradiction between the sharp increase in the number of students and the increasing tension of teaching resources. At the same time, some institutions of colleges and universities are constantly reforming and changing, which have brought unprecedented development and challenges to the teaching management of colleges and universities. In such an environment, how to get the maximum development at the minimum cost has become a new problem to be solved. Generally, teachers will accumulate a lot of data in the process of teaching

implementation, but now the processing method of these data is still in the primary stage of data backup, inquiry and simple statistics, so it is not able to deeply tap the potential value of these data. So how to excavate the value of these data, and how to use these data to rationally evaluate some aspects of teaching objectively, will be the focus of our research. Based on the above needs, this paper conducts data mining through the data of teaching evaluation and related data, and finds out the results of teachers' teaching quality evaluation, the factors of these factors and the quality problems of improving teaching methods [9].

### 4.2 Establishment of Data Mining Model

This project is based on data mining, teaching quality evaluation system, teacher management information system and comprehensive education system database data structure analysis goal, you can focus on two aspects of teachers' personal factors and teachers' attributes, classroom, establish mining model (1) teachers' personal factors mining model, teachers' gender, age, professional title, educational background and other personal factors, The relationship between teaching quality may exist [10]. In order to find out the related factors that affect the quality of teaching, this paper establishes the personal factors of teachers and mining model to analyze the relationship between these factors and the evaluation results of teaching quality. (2) In addition to the influence of teachers' personal factors, the evaluation results of teaching quality, the length of course time, the property of elective students in the teaching plan, and the number of elective students in the classroom, many other factors may also have a certain impact on the evaluation results. Therefore, this paper establishes a mining model of teachers' teaching attributes, analyzes the class attributes and teaching quality evaluation results between links, and finds out the related factors that affect the teaching quality.

### 4.3 Technical Platform of Data Warehouse

For the data warehouse in Colleges and universities, because of its large scale, it can meet the needs of customers by separating the storage management part, application processing and client application of the data warehouse. Therefore, it is particularly important to adopt the three-tier structure of CS. This three-tier structure mainly includes: the client layer based on workstation, the middle layer based on server and the third layer based on host; the host layer is mainly responsible for managing data sources and converting optional data sources; the service layer realizes the operation of data warehouse and data mart software, and stores the data in the data warehouse; The workstation of client layer will run the application program of query and report generation, and also store the partial data dumped from data mart or data warehouse [11].

# 5 Analysis, Design and Implementation of Teaching Quality Monitoring and Evaluation System

## 5.1 The Design Idea of the System

The prosperity of the country lies in education, talent training is the fundamental task of colleges and universities, and the quality of education is the lifeline of higher education institutions. Teaching quality evaluation is an important means to strengthen education management, and the promotion of improving teaching quality and methods is an important part of teaching quality monitoring system. Through the evaluation of teachers' teaching, we can provide effective feedback information for teachers' teaching, find out the shortcomings, increase pressure and motivation, promote teachers to improve their teaching level and professional quality, make teaching managers scientifically and comprehensively understand teachers' teaching situation, strengthen teaching monitoring and management, and make students play the main body consciousness [12].

In 2004, the Ministry of education started undergraduate teaching evaluation, and the evaluation of teaching quality is often held in universities [13]. In the past, the work of school teaching evaluation generally focused on the macro or meso level evaluation, for teachers and teachers' personal teaching quality evaluation. The research on evaluation methods is relatively less, most of them are manual operation mode, and completely adopt the manual data collection evaluation and processing, such as the display or academic staff in all levels of research. Evaluation methods and means, not only a heavy workload, low efficiency, evaluation results are not satisfactory reliability and effectiveness. In the face of more evaluation objects and large sample statistics, it is difficult to achieve the expected goal, and a small amount of data processing can still be carried out; it is particularly urgent and important to develop a simple and efficient teaching evaluation tool, and it is of great significance to establish an online teaching quality evaluation system based on campus network. Teachers' teaching quality evaluation system "in the process of classroom teaching quality evaluation of campus network, in the classroom teaching of students' evaluation of teachers' quality, teachers and teaching staff can not only improve the efficiency of teaching management, but also continue to accumulate evaluation data, providing data guarantee for future data analysis. Such a system can not only achieve paperless data acquisition process, but also be able to deal with large data [14, 15].

## 5.2 Design Principle of Evaluation Index

Student evaluation of teaching is a very complex educational practice, involving a wide range of content, with a strong interdisciplinary, combined with pedagogy, education management, curriculum and teaching theory, educational psychology, statistics, system science and other theoretical knowledge, and guided by these theories, a scientific model of student evaluation of teaching is formed in practice. Therefore, the planning and design of an excellent teaching quality monitoring and evaluation system must follow the following principles: scientific and objective, level oriented, simple [16, 17]. The system must be constructed under the guidance of theory, and the mode, method and means must be the needs of scientific higher education evaluation, so as to ensure the

balance of the rights of evaluation subject and object, and realize objective and fair evaluation. The fairness index system should have a level, which should focus on the instructors who care about the quality of teaching, increase investment in teaching, and improve the function of their teaching evaluation system, so as to be concise, Practical for users to understand and operate and system administrator management [18, 19].

## 6 Conclusion

As an important part of education informatization, a large amount of teaching information is collected in university teaching management system, but most of them have not been well mined and studied, so the application of data mining technology in university teaching management system has practical significance. In this paper, the association rule analysis and decision tree method of data mining technology are applied to evaluate and mine the data of teachers' teaching quality and students' academic performance in the teaching management system of colleges and universities, and some valuable rules are found, which provides decision support for the teaching management of colleges and universities, and makes a new exploration in the teaching reform and information construction of colleges and universities.

## References

1. Chang, T.: Application of data mining technology in the research of American universities. Fudan Educ. Forum (2), 74 (2009)
2. Zhu, Q.. On the application of data mining technology in higher education management. Silicon Valley (4), 59 (2009)
3. Li, Y.: Research on the application of data mining technology in university financial management informatization. Accountant (1), 34 (2009)
4. Jiang, H.: Research on the application of data mining technologyty Teaching. China Sci. Technol. Fort. (2), 98 (2009)
5. Chen, Q.: Research on the application of decision tree algorithm in university teaching quality evaluation system. Southwest Jiaotong University (2010)
6. Zhang, C.: Research on the application of data mining based on association rules in university teaching evaluation. Anhui University (2011)
7. Li, X.: Research on the application of data mining in university teaching quality evaluation system. North China Electric Power University (2010)
8. Chen, A., Chen, N.: Data Mining Technology and Application. Science Press, Beijing (2008)
9. Zhang, J., Zhang, X.: Data Mining Algorithm and its Engineering Application. China Machine Press, Beijing (2006)
10. Xie, B.: Data Mining Clementine Application Practice. China Machine Press, Beijing (2008)
11. Huang, D.: Data mining of user information and consumption behavior of mobile intelligent network. Huazhong University of science and technology (2006)
12. Zeng, C.: Research on data mining technology based on clustering algorithm. Central South University (2010)
13. Li, Y.: Application of data warehouse and data mining in college performance analysis. Dalian Dalian University of technology (2009)
14. Zhu, D.: SQL Server 2005 Data Mining and Business Intelligence Complete Solution, vol. 007, issue 10. Electronic Industry Press (20105)

15. Left branch. Research on incremental association rule updating algorithm. Chongqing University (2009)
16. Zheng, Y.: Research and application of data mining in teaching evaluation, vol. 6. Beijing University of chemical technology, Beijing (2011)
17. Fu, L.: Application of data mining in teaching evaluation, vol. 9. Nanjing University of technology, Nanjing (2007)
18. Wu, H.: Research on computer forensics technology. Xi'an University of Posts and telecommunications (2007)
19. Wang, Q.: Design and implementation of university teaching quality evaluation and analysis system, vol. 3. Xi'an University of technology (2008)