Journal of Electronic Research and Application, 2024, Volume 8, Issue 5
http://ojs.bbwpublisher.com/index.php/JERA
ISSN Online: 2208-3510
ISSN Print: 2208-3502

Construction and Practice of Teaching Evaluation System Based on Data Mining

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Abstract: The teaching quality evaluation system based on data mining technology can accurately and fairly identify the core driving factors to improve teaching quality. This method adopts the analysis of big data correlation rules, including data collection and processing preparation steps, builds the data warehouse of association rules, and then generates an educational quality evaluation framework using the principle of data mining. Based on this, this paper analyzes the construction design and method of the teaching evaluation system under data mining, hoping to provide help for the improvement of the teaching evaluation system and the improvement of teaching quality.

Keywords: Data mining; Teaching evaluation system; Correlation rules

Online publication: October 2, 2024

1. Introduction

Data mining technology emerged in the late 1980s, and its core task is to extract potentially valuable but undiscovered knowledge and information from complex, incomplete, noisy, and uncertain actual data. This process is a key part of the database knowledge discovery process. As interdisciplinary research means, data mining has been widely used in many fields. This paper aims to explore and apply data mining methods and techniques to construct a teaching quality evaluation system in local universities.

2. Index design

2.1. Evaluation index

Teaching quality management and evaluation system is the core tool used by educational administrative institutions and teachers to supervise and improve teaching quality. Its core functions include organizing teaching evaluation activities and collecting feedback information from various evaluation objects. The accuracy of the evaluation results is subject to the evaluation factors used, and the influence of different indicators on the results varies.

The whole system should reflect the diversified participation mechanism of the evaluation subjects, which

includes but is not limited to four aspects: student evaluation, peer evaluation, expert evaluation of the educational administration supervision group, and self-evaluation of teachers. Referring to the existing research, the designed data mining teaching quality evaluation index system is divided into three levels:

(1) Teaching attitude: The assessment at this level covers the evaluation of teaching attitude from students, colleagues, supervisors, and teachers, aiming to fully understand the performance of teachers' enthusiasm, patience, and professional attitude towards teaching work.

(2) Teaching content: Similarly, the evaluation of the teaching content also considers the feedback from students, colleagues, supervisors, and teachers themselves, focusing on the richness, accuracy, update of the teaching content, and fit with the teaching objectives.

(3) Teaching methods and teaching effectiveness: This level of evaluation focuses on the diversity of teaching strategies, interactivity, and quantitative evaluation of teaching effects. By collecting students' learning results, satisfaction feedback, and other data, teachers' innovation and effect on teaching methods are comprehensively evaluated [1].

2.2. Termination of index weight

The core components of the quality assessment system are index setting and weight allocation. This plan establishes about 40 three-level indicators. Therefore, the weight allocation of the indicators has a decisive impact on the final quality assessment results. The weight value reflects the relative importance of the index in the overall evaluation framework, and the higher the weight of the index, the more critical the role it plays in the evaluation process.

Given the specific situation, the combination of the hierarchical analysis method and expert consensus average method is adopted to determine the weight value of each level index scientifically and reasonably. This method first through hierarchical analysis, using the mathematical model between the relative importance of quantitative evaluation, and then combined with the collective wisdom of experts, through discussion and consultation consensus, finally calculate the weighted average of the index, to ensure that the weight setting reflects the results of the quantitative analysis, and into the field of professional judgment, to build a comprehensive and accurate teaching quality evaluation index system [2].

Firstly, the "1–9 scale" hierarchical analysis method is used to judge the index value, and the results show that this method can accurately reflect the relative importance of the indicators. Secondly, ten experts from related fields were invited to assign the weights to each index, and the average value of the expert opinions was calculated to ensure the rationality and credibility of the weight setting.

3. Construction of classroom teaching evaluation system model based on data mining

In colleges and universities, it is very important to develop a reasonable and effective classroom teaching quality evaluation system, which provides a scientific basis for the personnel departments to support their judgment on key decisions. The theoretical basis of hierarchical analysis is deeply discussed, and the data mining technology aims to optimize the evaluation index, to effectively solve the problem of the construction of a classroom teaching evaluation system.

3.1. Overview of the hierarchical analysis method

Hierarchical analysis is a powerful tool for constructing an evaluation system with multilevel elements. It skillfully integrates qualitative and quantitative analysis and is widely used in multiple fields. The core of this method

consists of four parts: build the hierarchical model, build the comparison matrix, calculate the weight vector, and make the consistency test. Through these four steps, hierarchical analysis can effectively help decision-makers make more scientific and reasonable decisions in complex and multi-dimensional evaluation scenarios [3].

3.2. Model of classroom teaching evaluation system

As a cutting-edge technology, data mining has a wide range of applications. **Figure 1** shows the classroom evaluation model based on data mining.

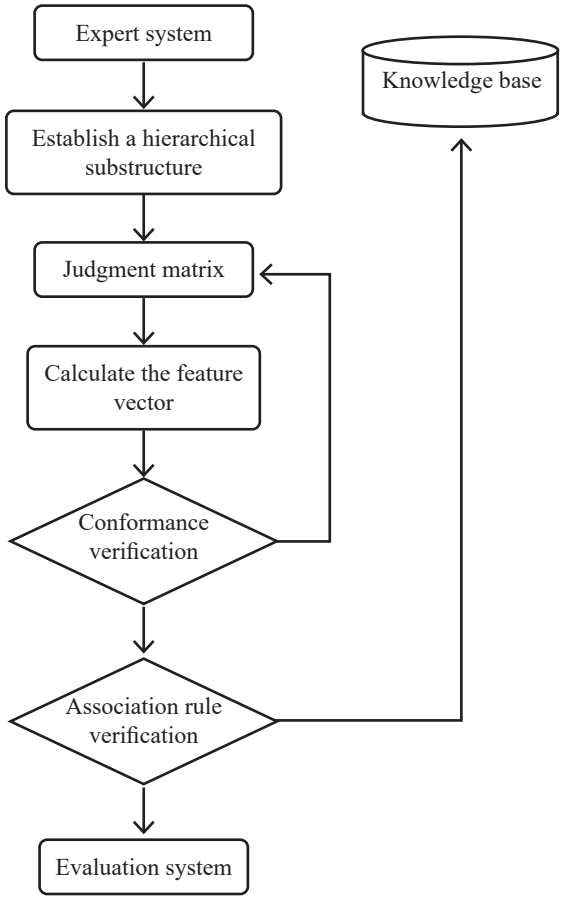

Figure 1. A classroom evaluation model based on data mining

This model first builds a hierarchical structure with the help of an expert system and then forms a judgment matrix on this basis. The feature vector of the judgment matrix is calculated, and this vector is tested for consistency and association rules. If both validations pass, classroom assessments are generated and the rules are stored in the knowledge base [4].

3.3. Application of the model in the construction of the classroom teaching evaluation system

The construction of a classroom teaching evaluation system is crucial because the appropriateness of the evaluation index will directly affect the quality of the evaluation. This paper distributes student questionnaires, collects evaluation forms from peers and experts, and analyzes them in depth, to extract a series of key indicators. These indicators have a direct impact on the evaluation results. To reasonably allocate the weight of the evaluation indicators and construct a set of scientific classroom teaching evaluation systems, the methodology of hierarchical analysis method is adopted. The specific implementation is divided into the following five steps.

3.3.1. Establish the hierarchical structure model of the evaluation index

Evaluation criteria can often be divided according to levels. With the help of artificial intelligence technology and detailed professional information in the knowledge base, a hierarchical structure can be constructed, taking into account the uniqueness of classroom teaching quality evaluation. “Classroom teaching quality” is at the top level, and it is the goal of the whole evaluation system.

3.3.2. Construct a pairwise comparison judgment matrix

According to the widely recognized pairwise comparison and scoring criteria, the relevant evaluation indicators are compared and scored one by one through the comparative analysis method. Under the framework of the evaluation system, the expert team scores the first-level index and its second-level subdivision index, thus forming a pairwise comparative evaluation matrix. The matrix needs to satisfy the positive and reciprocal quality, that is, the comparison results between any two indicators are independent of each other and have a consistent direction of comparison [5].

3.3.3. Calculate the weights by the standard column average method

The weight values of the first-level and second-level indexes in the classroom teaching evaluation system are calculated respectively. This process involves normalizing the data for each column to ensure the rationality and accuracy of the weights. Regarding the issue of language evaluation, some scholars have designed an interpretative automatic evaluation system for interpreting teaching from the perspective of new liberal arts translation studies by analyzing the elements of interpreting tasks. Based on the interpretative theory analysis of artificial intelligence, corresponding sustainable optimization paths have been proposed to improve the transparency, credibility, and accuracy of the system [6].

3.3.4. Consistency test

Consistency test is the key step to ensure the rationality of the weight allocation of evaluation indicators. Its importance cannot be ignored, and it even can achieve some degree of weight adjustment to correct the possible unreasonable allocation. Once the index weight is calculated by the hierarchical analysis method, it can usually verify the effectiveness and superiority of the method in weight allocation [7]. The use of the hierarchical analysis method can not only scientifically quantify the importance of different evaluation indicators, but also ensure the logical consistency and rationality of the weight allocation process, which provides a solid foundation for the construction of a fair and just teaching quality evaluation system [4].

3.3.5. Verification of association rules

To verify the integrity of the evaluation system, the Apriori algorithm is used in the data mining field to mine the association rules between the evaluation data and the evaluation results. This process includes the following steps.

Firstly, the evaluation data is collected from students, peer teachers, and experts around the evaluation index of classroom teaching quality. Subsequently, a proportion of teachers’ evaluation records were randomly selected from these data for subsequent analysis. In this process, we will focus on the association between the evaluation data and the final evaluation results. There is a closer and more significant correlation between the indicators with high confidence and the evaluation results. The constructed classroom teaching evaluation system not only comprehensively covers the key evaluation elements, but also shows a high degree of effectiveness in practical application [8].

4. Implementation of teaching quality evaluation system

4.1. System development tools

The key to establishing an efficient teaching quality evaluation system lies in developing a comprehensive application platform, which can be implemented through data mining techniques. As a unified web application platform, ASP.NET is an ideal choice due to its cross-device and browser compatibility, strong security, and flexible scalability [9]. Due to the high demand for computing resources in data mining tasks, it is recommended to use servers or workstations with at least 32 GB of memory and 100 GB of hard disk capacity to ensure data processing efficiency and rapid system response. Software environments should focus on stability and user-friendliness. The Windows operating system has become an ideal platform for running due to its mature stability and intuitive interface. Additionally, for system security, it is recommended to deploy high-performance antivirus software to provide comprehensive protection [10].

In terms of development tools, it is recommended to use the ASP.NET framework, with its powerful web development capabilities and rich component library, which can effectively improve development efficiency and application quality. It is recommended to use Microsoft SQL Server for the backend database, which meets the requirements of big data storage and management with its high performance, reliability, and security [11].

4.2. Data preprocessing

In the evaluation system of teaching quality in universities, when faced with a large amount of data, preprocessing operations are first required, including integration, cleaning, discretization, and summarization, to provide a clean and orderly dataset for subsequent data mining. Although the traditional percentage-based evaluation method is common, it is subjective and difficult to comprehensively and objectively reflect teaching effectiveness. Therefore, the introduction of a grading system, using five levels of "poor," "pass," "medium," "good," and "excellent" instead of a percentage system, makes the evaluation more intuitive and convenient. The specific conversion method is 0 to 60 points for "poor," 60 to 70 points for "pass," 70 to 80 points for "medium," 80 to 90 points for "good," and 90 to 100 points for "excellent," aiming to simplify the evaluation scale [12]. The focus of the data mining stage is on the mathematical analysis results based on the data, such as evaluation results and related information, which are the core of the research. Therefore, accurate processing and analysis of evaluation result data is the key to obtaining precise data insights, ensuring that the analysis conclusions have high credibility and practicality [13].

5. Application of association rule mining in this evaluation system

5.1. Association analysis of "professional teachers"

Firstly, the system designer organizes all teachers and students in the school to conduct a comprehensive evaluation and scoring of specific professional teachers based on established teaching evaluation indicators. Subsequently, the teaching evaluation system automatically collects and organizes these evaluation data, categorizes and summarizes the data according to different evaluation indicator categories such as teaching methods, classroom interaction, student feedback, etc., and conducts preliminary analysis to calculate the data performance and potential association rules under each indicator category [14]. Secondly, the system will integrate and process the collected professional teacher evaluation data, and automatically calculate the overall teaching score of each teacher based on preset calculation logic. The evaluation criteria usually adopt a five-point scoring system, where 90 to 100 points are "excellent," 80 to 89 points are "good," 70 to 79 points are "medium," and 60 to 69 points are "passing." In this way, the teaching ability of each teacher is quantitatively evaluated [15]. Finally, by conducting in-depth association rule mining on teaching evaluation data, the system can discover the intrinsic connections between different evaluation dimensions, as well as which factors most directly affect the teaching evaluation results [16].

These findings not only contribute to the formation of detailed data reports but also provide managers with a new perspective to understand the factors influencing teaching effectiveness.

5.2. Correlation analysis of "professional subjects"

If it is difficult to find a clear reason for the low evaluation scores of professional teachers from the perspective of individual teachers, an in-depth analysis can be attempted from the perspective of "professional subjects." Firstly, it is necessary to conduct a detailed correlation analysis between the teaching content and the teaching effectiveness of the course. By comparing multidimensional data such as student participation, homework completion, and exam scores, identify the relationship pattern between teaching content and actual teaching effectiveness [17]. Secondly, establish an evaluation system, in which teaching scores between 90 to 100 points are "excellent," 80 to 89 points are "good," 70 to 79 points are "medium," and 60 to 69 points are "passing." Finally, based on the results of the correlation analysis, teaching evaluation managers should objectively analyze the actual problems that exist in the curriculum and organize experts in relevant fields for in-depth discussions [18]. Through the collision of collective wisdom, targeted improvement measures are proposed to rapidly enhance the teaching quality of the course.

5.3. Mining association rules between teacher files and teacher ratings

The knowledge structure of teachers has a profound impact on the quality of teaching. To more accurately evaluate the quality of teaching and its influencing factors, this article takes "dual teachers" as a case study and deeply analyzes their correlation. Setting four evaluation levels: excellent, good, moderate, and passing. By using the Apriori algorithm for data analysis, a significant correlation was found between "dual teachers" and overall evaluation scores [19]. This indicates that the teaching content of "dual teachers" is highly attractive to students, and their learning outcomes are good. They may integrate practical experience into teaching, stimulate students' interest, and improve learning effectiveness. The correlation analysis between teacher files and teaching evaluation provides a scientific basis for teaching management in universities. The results show that by collaborating with enterprises and introducing dual-qualified teachers, universities can significantly improve the quality of teaching [20].

6. Conclusion

The application of data mining technology in the evaluation system of higher education has profound significance, and it plays an indispensable role in building a data-driven teaching evaluation system. Through the application of this system, not only can the overall quality of teaching be significantly improved, but weak links in the teaching process can also be accurately identified, providing a strong basis for optimizing teaching strategies and strengthening core quality education.

Disclosure statement

The auth or declares no conflict of interest.

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