Evaluating English Teaching Project Quality through Deep Decision-Making and Rule Association Analysis in E-Learning

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Abstract. Universities have accumulated a vast repository of course data through long-term teaching endeavors. Utilizing these data resources to analyze the status of course teaching and offer decision support for enhancing teaching quality is of significant research value. This study introduces a course evaluation system leveraging association rules and cluster analysis. It delineates the system's functional requirements, conducts preprocessing of course evaluation data, and employs FP-growth association rules to analyze student performance data. Subsequently, K-means clustering is applied to enhance data evaluation accuracy. The research focuses on establishing an evaluation index system for university English teaching quality within "Thinking and Government." Drawing from sample survey results, the study identifies and analyzes primary issues with the evaluation method and proposes corresponding suggestions. These findings serve as crucial reference points for advancing reforms in college English courses.

Keywords: E-Learning; teaching activities; teaching quality; FP-growth; K-means; college English.
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1 INTRODUCTION

The university English course is both instrumental and humanistic, which puts higher requirements for the effective, targeted, and affinity strengthening of ideological and political education in the professional courses' Civics elements, curriculum and teaching methods, etc[13]. The research of the university English course needs to be strengthened and continuously improved to meet the needs of student's growth and development. How to plant this responsible field of English courses in college is especially important for the smooth implementation of curriculum thinking and politics[19]. The critical evaluation link to test the harvest of this field is the evaluation link. The construction of a scientific and standardized, practical evaluation system will meet the requirements of the university

English course, the development of students, and the development of teachers so that it will positively impact the evaluation of the teaching of the university English course. The evaluation system will eventually play a service role in the subsequent decision-making and promote the realization of the fundamental goal of "establishing moral education for people"[3].

At present, the research results on the establishment of the quality evaluation system of college English teaching under the study are relatively few, and the related evaluation methods vary widely and have mixed reviews in various universities; most of the studies point to the macro path or teaching pedagogy, and many scholars also mention the assessment methods and evaluation modes in their studies, but only briefly summarize them[17]. Drawing on the theory of result-oriented education for engineering certification, the evaluation system of college English cultivation goal achievement proposes improvement measures in three latitudes: knowledge transfer, ability cultivation, and value shaping. It traces each link in the process of education and teaching[20]. The scientific and reasonable articulation of professional knowledge points with the knowledge points of Civic Education and the practical evaluation of the curriculum can promote the development of teaching reform, achieve sound beneficial effects, and ensure the simultaneous improvement of the quality of college English teaching and the quality of Civic Education of the curriculum. How do we improve the evaluation body of teaching quality under the course Civic Education from the level of process and result, all-round and multi-level, static and dynamic, that needs to be solved[9]?

The fundamental purpose of teaching quality management is to form a continuous improvement mechanism for teaching quality and to improve teaching quality [28]. Curriculum quality is the primary factor affecting teaching quality improvement in higher education, and all higher education reform concepts and ideas are ultimately implemented into and through the implementation of the curriculum [7],[6]. Established experience shows that external factors such as investment in educational resources, external accountability, and evaluation do not necessarily improve the quality of education, and promoting the quality of teaching and learning within higher education is the fundamental way to solve the problem. Therefore, by collecting, analyzing, and evaluating information on the operation status of undergraduate courses, teachers, students, experiments, and videos, establishing an undergraduate course evaluation system and its supporting system and using it in undergraduate teaching management services will enhance the core competitiveness of education reform[2]. How to use this teaching information rationally to obtain potential valuable knowledge for teaching and make forward-looking decisions has become an urgent problem for universities to solve.

We design and implement a course evaluation system based on association rules and clustering analysis for course evaluation technology to improve teaching quality and provide data analysis and decision support functions. The system addresses the problem that the traditional course evaluation system singularly takes grades as the only criterion, uses a more objective combination of quantitative and qualitative course evaluation principles, breaks the geographical and time constraints, saves a lot of labor and time costs, and automates the collection of course evaluation data and course evaluation processing. At the same time, systematic analysis of course data has yielded a decision-support basis that helps improve teaching quality and provides teachers and professors with professional responsibility on a reference basis for continuous improvement.

2 CONSTRUCTION OF EVALUATION INDEX SYSTEM

According to the competency theory proposed by[4]. As a teacher of English at the university level cultivates high-quality language skills, professional skills such as teaching experience and teaching ability are the main manifestations of teachers' competencies; subjective "professional attitudes or values" and objective "professional knowledge and skills" are the main manifestations of teachers' competencies[27]. Personal evaluation is quantifiable, observable, perceptible, and imitable; objective evaluation is measurable and descriptive, and teachers' excellent behavioral performance can be demonstrated in concrete form or measured by a specific quantity or index.

3 PRINCIPLES OF CONSTRUCTING EVALUATION INDEX SYSTEM

According to the actual need for teaching quality evaluation, the setting of the index system adheres to the following principles.

1. The design of evaluation indexes should honestly and objectively reflect the inner laws of teaching, the current situation, the existing problems, and the development potential and conform to the basic principles of pedagogy and psychology[22].

2. The designed evaluation index system and its evaluation results are easy to compare between schools and can be generalized to different schools and majors.

3. Not only should the complex factors of interdependence and mutual constraints be considered as a whole and the system concept be adhered to, but also the system should be clearly organized and hierarchically structured to avoid the index system being too cumbersome and complicated to be operable for later evaluation and data collection.

4 QUALITY EVALUATION INDEX SYSTEM

Based on the above principles, six first-level and 19 second-level evaluation indicators are set considering the teaching plan, teaching methods, teaching process, teaching attitude, and teaching effectiveness. Teachers organize and record evaluation activities, guide and help students, and students act as the center of the evaluation system to achieve three-dimensionality, diversity, pluralism, and flexibility in evaluation contents, subjects, evaluation standards, and evaluation methods[24][21]. Avoiding summative evaluation and overcoming problems such as simplistic evaluation methods, single subject, and lack of comprehensiveness and accuracy.

Index	*concrete content*
plan	*Formulate a comprehensive curriculum ideological and political teaching plan.*
	Timely adjust the teaching plan.
devices	*The teaching informative*
	The teaching can reflect frontier.
	Organizing diversified ideological and political teaching
	Open or elective courses
	Participate in construction online teaching.
	Undertake teaching reform
process	*conforms to the syllabus, reasonable and rich*
	Pronunciation standard, fluent; Explain clearly and methodically.
	Care for students, teach, and educate people.
	The class is energetic and infectious.
attitude	*manage classroom discipline*
	Be kind and generous.
	Answer questions carefully
	Pay attention to the feedback on homework information.
	The class time was arranged reasonably.

effectiveness	*The students can solve problems, learn, and innovate*
	The school curriculum Ideological and political participation
	Students listen carefully

Table 1: Teaching quality evaluation.

5 SATISFACTION QUESTIONNAIRE DESIGN

The satisfaction survey differs from the teaching work level and professional assessment[5]. A sample questionnaire is designed, and a scoring method is used to understand the degree of influence of each index on teaching quality in people's minds. Through the questionnaire survey, optimize the index system, eliminate unreasonable items, and add new indicators appropriately. The questionnaire was divided into two parts: the first part was a scoring scale, and the second part was a supplementary question asking the respondents to propose new indicators[10].

Secondary index
Formulate a comprehensive curriculum, ideological and political.
Timely adjust the teaching plan.
content-rich and informative
The teaching content can reflect the frontier.
The teaching of Ideological and political
Open or elective courses
online teaching resources
Publish teaching-related papers and monographs
The lecture information is reasonable and rich

Table 2: Teaching quality evaluation index.

Table 3 shows each respondent's satisfaction with the scale of the respondents' overall satisfaction. The second is the satisfaction of all respondents with each indicator, the sum of individual indicator scores used to optimize individual indicators. Table 4 is the personal indicator satisfaction score scale[8][23].

Satisfaction	*Score range*	*Satisfied*	*Dissatisfied*	*Very dissatisfied*
Score range	*64-80*	*48-64*	*32-48*	*0-32*

Table 3: Respondents' overall satisfaction scale.

Satisfaction	*Score range*	*Satisfied*	*Dissatisfied*	*Very dissatisfied*
Score range	*208-260*	*156-208*	*104-156*	*0-104*

Table 4: Scale of satisfaction with individual indicators.

6 COURSE EVALUATION BASED ON ASSOCIATION RULES AND CLUSTER ANALYSIS

6.1 Analysis of Association Rules

The traditional Apriori algorithm generates many candidate item sets and requires repeated scanning of the entire database to complete pattern matching, which is particularly expensive. The frequent pattern growth (FP-growth) algorithm can mine the whole set of regular items without generating a costly set of candidates [14],[16],[29].

Based on the preprocessing of the data, association rules are mined from the examination results data to discover the interplay between different courses, to help the professor responsible for the profession to reasonably formulate the professional training plan, to cultivate more comprehensive professional talents, and to improve the quality of teaching further.

Based on not ignoring important rules and not generating many useless rules, the minimum support count was finally set to 50, and the minimum confidence level was set to 0.85 after several experiments. Some of the association rules of course mined using the FP-growth algorithm on course grade data are shown in Table 5.

Antecedent	*Consequent*	*Confidence level/%*
Linear algebra、	*Discrete mathematics*	*90.00*
Theory of probability		
Digital logic		
Assembly language	*Operating*	*96.29*
Microcomputer principles	*system*	
College english、	*Computer*	
Introduction to computer	*pirofessionalenglis*	*88.76*
Assembly language、	*Microcomputer*	*97.23*
Composition principle	*principles*	
Computer architecture		

Table 5: Course association rules.

6.2 Course Grade Data Type Dissimilarity Metric

The traditional K-means algorithm randomly selects k samples from the dataset as clustering centers when choosing the initial clustering centers, and the different initial clustering centers quickly lead to entirely dissimilar clustering results. In the face of different data types, data mining techniques often require the use of varying dissimilarity measures [11],[25],[26]. In this paper, student achievement data are generally numerical data, which are transformed into binary data after discretization preprocessing, and their phase dissimilarity measures are introduced here.

Student achievement data are expressed as integer or absolute values. Different units of measurement affect the clustering results, so the data should be normalized before calculating the distance to minimize the influence of the units of measure on the clustering results. Let student achievement data $\boldsymbol{i} = (x_{i1}, x_{i2}, \cdots, x_{ip})$ and $\boldsymbol{j} = (x_{j1}, x_{j2}, \cdots, x_{jp})$ contain p numerical attributes, i and j represent student achievement vectors, and the typical distance measures are as follows:

1. Euclidean distance

$$d(i,j) = \sqrt{\sum_{k=1}^{n}\left(x_{ik} - x_{jk}\right)^2} \tag{1}$$

2. Manhattan Distance

$$d(i,j) = \sum_{k=1}^{n} \left|\left(x_{ik} - x_{jk}\right)\right| \tag{2}$$

3. Minkowski distance

$$d(i,j) = \left(\sum_{k=1}^{n} \left|x_{ik} - x_{jk}\right|^{p}\right)^{1/p} \tag{3}$$

Discrete test score data have only two states, 0 or 1, where 0 means that the student test score is less than or equal to the average score, and one means that the student test score is greater than the average score. The binary symmetric phase anisotropy is calculated as follows :

$$d(i,j) = \frac{b+c}{a+b+c+d} \tag{4}$$

6.3 Course Evaluation Results

The data set shown in Figure 1 is selected. The data set contains 8-grade data samples, the graph's horizontal coordinates representing the usual grades, and the vertical coordinates representing the exam grades [12]. To simplify the calculation, the serial numbers of the samples in the dataset (usual grades, exam grades) are No. 1 (3,4), No. 2 (4,4), No. 3 (3,3), No. 4 (4,3), No. 5 (0,2), No. 6 (1,2), No. 7 (0,1), No. 8 (1,1).

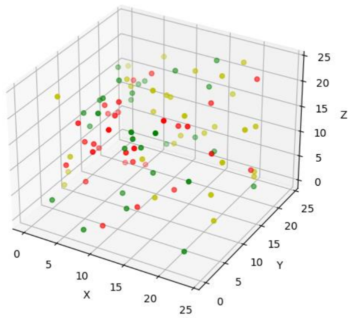

Figure 1: Example of K-Means++ algorithm.

Assuming that the algorithm randomly selects number 6 as the initial cluster center, the distance D(x) from each sample in the dataset to the initial cluster center and the probability P(x) of being selected as the next cluster center. In this example, the interval is divided into [0,0.2), [0.2,0.525),..., [0.975,1], and if the generated random number is 0.3, then the random number falls into the interval [0.2,0.525), according to which number 2 is selected as the next cluster center. According to the value of S, the probability that the second initial cluster center is one of No. 1, No. 2, No. 3, and No. 4 is 0.9. The four points are precisely the points farther away from the first initial cluster center, which also verifies the idea of the K-means++ algorithm that the points farther away from the existing cluster center[1]. Repeat the above steps using the roulette wheel method to generate all the required k initial clustering centers.

The K-means++ algorithm solves this problem by mixing different types of students from the test data, even if there is some variation in test difficulty. K-means++ algorithm clusters discrete mathematics courses, and the final clustering center results obtained are shown in Table 6.

Type	*Standardized test scores*	*Stan darted regular scores*
First	*0.9862*	*0.8824*
Second	*0.9598*	*0.7149*
Third	*0.9422*	*0.4379*
Fourth	*0.6000*	*0.5975*

Table 6: Final clustering centers for discrete mathematics courses.

As can be seen from Table 7, Category 1 students performed well on both their exams and their regular grades; Category 2 students performed well on their exams, but their steady performance was more average; Category 3 students performed well on their exams, but their stable performance was terrible; and Category 4 students hovered around the passing line on their exams and common grades and performed poorly.

Analyzing the above clustering results, the learning characteristics of various types of students in this course can be found, which leads to the following conclusions that help teachers improve the quality of teaching[30].

1. Category 1 students mastered the course proficiently, performed well in general, and eventually achieved excellent grades.

2. Students in Category 2 have little difference in their course mastery compared with those in Category 1. Still, their usual performance could be better due to a certain degree of absence, failure to submit assignments, poor completion of experiments, etc. These students must strengthen their self-discipline and improve their requirements in their usual course study.

3. Students in category 3 perform well on exams but need better grades in regular classes. This may be because they have achieved good grades because of intense revision before exams. Still, they may have more severe absenteeism, failure to turn in assignments, and failure to complete labs in regular classes, causing their overall grades to be much lower than their exam grades[18].

4. Category 4 students have poor performance in both exam and regular grades and have low mastery of course knowledge, which may be due to not studying the course content seriously or poor learning ability of students[15].

In summary, teachers need to focus on the usual performance of students in categories 3 and 4, who tend to have a poor learning attitude when teaching the course. There may be some students in category four who need better learning ability. These students must be encouraged to ask teachers and classmates more questions in the usual course as soon as possible to understand the knowledge points they do not understand. At the same time, diligence can make up for poor performance.

In addition, by analyzing the above association rules. Further conclusions that can help managers make decisions can be summarized, as shown in Figure 2.

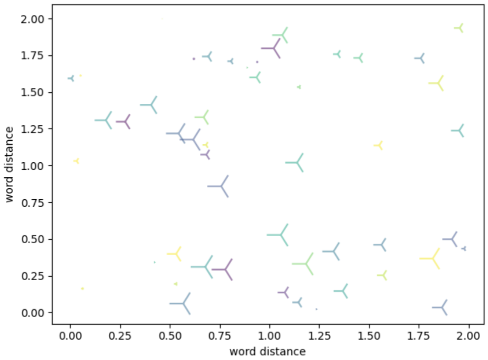

Figure 2: Word scatter diagram.

As seen from Fig 2, arranging University English, assembly language, linear algebra, probability theory, and digital logic in the training course for first- and second-year students is more reasonable, which can help students build a solid foundation for their expertise in subsequent classes.

Since the courses in Microcomputer Principles, Computer English, and Computer Operating Systems are relatively comprehensive, they are difficult for some students with poor learning ability. Therefore, these courses are more suitable for junior students.

7 CONCLUSIONS

Improving the evaluation index system of the quality of college English teaching aligns with the torrent of time research on curriculum thinking and politics. The optimized index system can reflect the specific status of college English teaching more comprehensively and is also a powerful motivation to promote the realization of the reform goal of curriculum thinking and politics, which is of great significance to the investment practice and theoretical system improvement in terms of the effectiveness of human education. In this paper, we use the FP-growth algorithm for correlation rule analysis and the K-means++ algorithm for clustering analysis on course achievement data to get a decision support basis that can help improve teaching quality, provide teachers and professors with professional responsibility with a reference basis for continuous improvement, provide students with more refined and personalized services, and effectively improve student achievement. Integrating deep decision-making and rule association analysis empowers educators and project managers to harness the power of data to shape more effective and impactful English teaching projects in e-learning settings. This approach illuminates the path to success and instills a culture of continuous improvement, driving education forward with evidence-based strategies and insights.

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