Comput Syst Sci & Eng (2020) 3: 183–189

International Journal of
Computer Systems
Science & Engineering

Japanese Teaching Quality Satisfaction Analysis With Improved Apriori Algorithms Under Cloud Computing Platform

Lini Cai[*†]

Hunan City University, Yiyang Hunan, 413000, China

In this paper, we use modern education concept and satisfaction theory to study the construction of a system used to evaluate Japanese teaching quality based on a satisfaction model. We use a cloud computing platform to mine the rules of Japanese teaching quality satisfaction by using an improved Apriori algorithm to explore the impact of measurement indicators of teaching objectives, processes and results on overall satisfaction with Japanese teaching practices, so as to improve Japanese teaching in the future. Scientific decision-making, improvement of teaching practices, transformation and innovation of students' learning methods provide data reference and theoretical support.

Keywords: Relevance Analysis; Improved Apriori Algorithm; Japanese Teaching Quality Evaluation; Satisfaction Model

1. INTRODUCTION

After the rapid expansion of higher education, it is now entering the stage of developing improved teaching and learning practices, for which satisfaction with teaching quality is one of the main indicators [1]. In 2012, the Ministry of Education issued the "Opinions on Improving the Quality of Higher Education in the Ministry of Education", the core of which concerned the improvement of teaching practices and the promotion of educational and teaching reforms [2]. Therefore, the quality of teaching has become a hot topic of discussion among stakeholders including society, government, schools, parents and students. Through evaluation, suggestions and improvement, it has become the focus of research for scholars and society [3]. The relevant literature indicates that, initially, studies focused on the quality of teaching that occurs in the classroom, and comprehensively evaluated the existing frameworks based on a thorough consideration of relevant data for the classroom, teachers and students. With the concept of education evolving, and changes occurring in teaching methods and teaching environments, an increasing number of researchers believe that the perception and recognition of teaching quality is a dynamic process which needs to be based on big data, large sample discovery and reasoning. This has prompted scholars to investigate and propose various systems for the evaluation of teaching quality. None of these studies has comprehensively considered a multi-rule mechanism for correlating teaching quality and goals, processes, and results; instead, they consider fewer factors such as system rule guidance, object adaptation, and moderate satisfaction [4,5]. Based on the recent evaluation data for Japanese classroom teaching quality over a college semester, this paper conducts an in-depth analysis of the relevance of various indicators of Japanese teaching quality based on the satisfaction model, and uses the Apriori algorithm to mine the index association mechanism under a

[*]e-mail: 253678645@qq.com
[†]Corresponding author: Lini Cai

cloud computing platform [6]. In this paper, in order to find the influencing factors of teaching satisfaction, the rationality of the classification methods of individual indicators in the current teaching evaluation system is explored, as is the impact of each individual indicator on the overall teaching evaluation [7,8].

The Apriori algorithm is the first association rule mining algorithm and the most classic algorithm. It uses the iterative method of layer-by-layer search to find the relationships of item sets in the database to form rules. The process consists of connections (class matrix operations) and pruning (removing those intermediate results that are not necessary). In the algorithm, an item set is a collection of items [9]. The set containing K items is a set of k items. The frequency with which an item set appears indicates the number of transactions that contain the item set, known as the frequency of the item set. If an item meets the minimum support, it is called a frequent item set [10].

The Apriori algorithm is a frequent item set algorithm used for mining association rules, and one of the most influential algorithms for mining frequent item sets of Boolean association rules [11]. The core idea is to mine frequent item sets through two stages: candidate set generation and plot closed down detection. The core is a recursive algorithm based on the idea of two-stage frequency set [12–13]. The association rule belongs to a single-dimensional, single-layer, and Boolean association rule in classification. [13]. The Apriori algorithm has been widely used in various fields such as business and network security. The algorithm is simple and clear, without complicated theoretical derivation, and is easy to implement [14].

2. ANALYSIS OF ASSOCIATION RULES BASED ON THE CLOUD PLATFORM

2.1 Efficiency Analysis of Apriori Algorithm Based on Cloud Platform

The classical algorithm in association analysis is the Apriori algorithm proposed by R. Agrawal et al., which is a very influential algorithm for mining frequent itemsets of association rules. It mines Apriori properties step by step: all non-empty subsets of frequent item sets must be frequent. According to the frequent k-item set, a frequent $(k + 1)$-item set candidate is formed, and the database is scanned once, and the kth iteration (k>1) is completed, and the complete frequent $(k + 1)$-item set $l_k + 1$ is found. The advantages of the Apriori algorithm are that it is simple and easy to understand; however, there are also two shortcomings. 1. When the number of frequent 1-item sets L1 in the transaction database is relatively large, the candidate 2-items generated by the frequent 1-item set then C_2 is very large, C_2 consists of C_2^1 2-item sets; 2. In order to generate frequent set LK from candidate set C_K, it is necessary to repeatedly scan the transactions in the database and calculate the support of each candidate set in the candidate set CK. Therefore, when the number of transactions in the transaction database is large, the overhead of scanning the database will become very large. Therefore, although the Apriori algorithm uses its own feature to compress the size of the frequent set and improve the mining performance, it still has some shortcomings. First, the large-scale database itself has a large number of frequent sets, and after the algorithm that large number of frequent candidate sets are generated. Secondly, the number of SCAN data when the algorithm is running is relatively large and repeated, which wastes time.

2.2 Apriori Algorithm Based on Hadoop Platform

We use the key-value property of the MapReduce parallel programming model to perform Map blocking processing on the input raw data set. The main process distributes the data into each computer in the Hadoop cluster; then the parallel algorithm is used on each computer. The block data is processed as follows:

(1) The main process generates a candidate set by comparing the block data set with the original data set;

(2) Then, by comparing a candidate set with the original data set, the support degree of each item can be calculated, and the support degree is compared with the support degree given in the program to obtain a frequent set;

(3) Next, a frequent set produces a two-term frequent set;

(4) This iteratively continues until the k item candidate set is generated, and the k item candidate set is compared with the original data set. If there is a k item candidate set, the iterative execution is continued, and if not, the k-1 item candidate set is finally obtained.

The above process is the candidate set of blocks calculated by the Map process on each computer. The Reduce process in the MapReduce programming model combines the support number of k-item candidate sets for each block acquired by the Map process on each computer to obtain the support number of global k-item candidate sets. The support number of global k-item frequent item sets can be calculated from the support number of global candidate sets. After calculating the global k-item frequent item set of a block, each computer will start the next Map process to process the second data block, which will cycle in turn until all data blocks are processed by the architecture. Figure 1 depicts the implementation of MapReduce parallelization of the improved Apriori algorithm.

When the traditional Apriori parallel algorithm is executed, each computer in the cluster will process the same part of the task, so that each part of the task is executed many times, resulting in a waste of computer resources. When the parallel algorithm based on MapReduce programming model is executed, each computer executes only one of the tasks and saves the cluster computing resources.

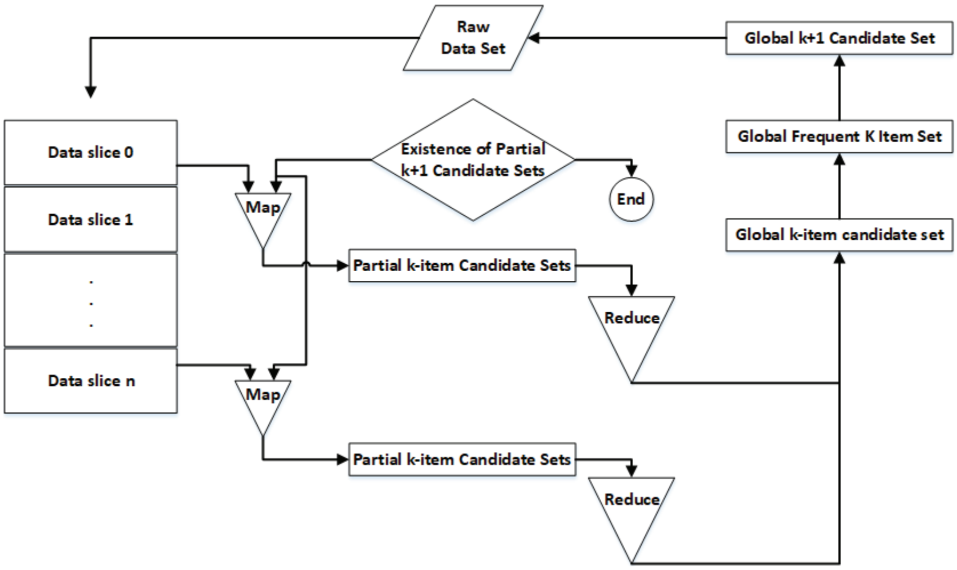

Figure 1 MapReduce Parallelization Flow Chart for Improved Apriori Algorithms

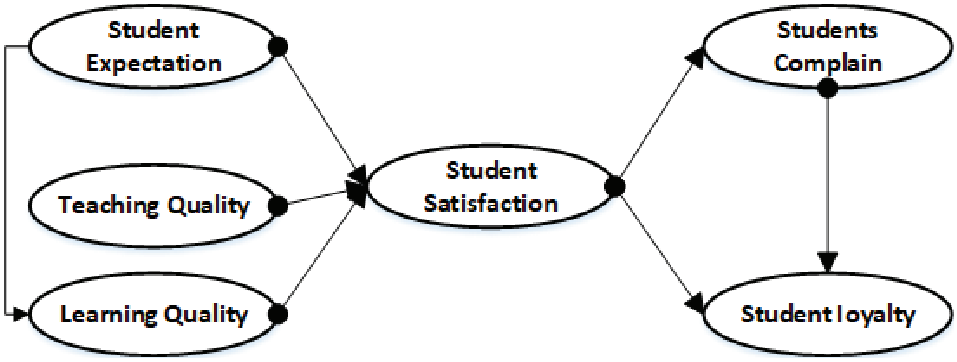

Figure 2 Schematic diagram of teaching quality satisfaction model

3. CONSTRUCTION OF TEACHING QUALITY MODEL IN HIGHER VOCATIONAL COLLEGES BASED ON SATISFACTION MODEL

3.1 Satisfaction Index

Satisfaction theory was first applied in the field of economic management by Cardozo, and then rapidly found applications in various fields in developed countries. Education services provided by schools can be regarded as a commodity that can be exchanged, with students as customers. Students, as the primary customers receiving university education services, purchase commodities. Determining whether or not the quality is satisfactory, and the degree of student satisfaction, should become an important indicator of the level and quality of university offerings.

At present, student satisfaction measures are being used as an effective tool for determining the quality of teaching and the level of discipline construction, and has become an important indicator in the university evaluation system. The evaluation of student satisfaction is a scientific and effective self-administered method. Administrators in tertiary education institutions can measure and scrutinize students' satisfaction with the teaching process of colleges and universities. Based on the teaching satisfaction concept which is a feature of modern education practices, we propose the model shown in Figure 2.

In the teaching quality satisfaction model, the ACSI model was modified. Considering that there is no necessary connection between the quality of teaching and tuition fees, the structural variable of perceived value is deleted. Currently, classroom teaching comprises teaching by the teacher and learning by the student. Therefore, the perceived quality is divided into two parts: teaching quality and learning quality. Finally, six structural variables - student expectation, teaching quality, learning quality, student satisfaction, student complaints and student loyalty - are designed. Student satisfaction is the ultimate goal. The expectations of student, quality of teaching, and quality of learning are the reasons for student satisfaction. Student complaints and student loyalty are the result of student satisfaction.

3.2 The Construction of Satisfaction Measurement Index for Teaching Qualit

The design of an evaluation system to determine Japanese teaching quality begins with the analysis of goals, captures the

Table 1 Classroom Teaching Quality Assessment Table (Students).

First-level Indicators	Secondary indicators	Score	Grade
Teaching Attitude	Academic rigor, as a teacher; on time to attend and leave classes; not arbitrary mediation of classes	10	AB
	Listen to the students' opinions modestly and improve actively. Teachers are fully prepared for class	10	AB
	Enriched content and large amount of information	10	AB
Content of Courses	Step by step, with prominent emphasis and clear analysis of difficulties	10	AB
	The content of the course is few, precise and easy to understand.	10	AB
Teaching Method	Stimulating Students' Interest in Learning	10	AB
	Enlighten students' thinking and teach them to study scientifically	10	AB
Teaching Effectiveness	The language is vivid, refined, accurate and logical	10	AB
	Classroom atmosphere is active	10	AB
	Students have learned a lot from this course	10	AB

Table 2 The Correspondence Table of General Teaching Quality Evaluation Index and Teaching Quality Satisfaction Model Variables.

Index	Students' Expectation	Teaching Quality	Learning Process	Teaching Satisfaction	Teaching Complaints	Teaching Loyalty
Variable	A12, C31	B21, C33	B22, B23	C32, D42	A11, D41	A11, C31

essential attributes of teaching quality, lists several elements, and selects important ones by means of an exhaustive approach comprising three methods: empirical indexing, questionnaire survey and principal component analysis. The key elements are used as indicators, and then gradually revised and improved in practice. On this basis, the framework of an evaluation system for Japanese teaching quality is designed, consisting of first-level indicators and second-level indicators. All indicators constitute an overall evaluation system. The commonly-used Japanese teaching quality evaluation system consists of four parts: teaching attitude, teaching content, teaching method and teaching effect. Details are given in Table 1. What is lacking in this model is data pertaining to teachers, students, and the course. According to the definition of four aspects, the measured values of each variable in the teaching satisfaction model can be obtained according to the definition of each index.

From the definition connotation analysis of the secondary indicators in Table 1, it can be found that the measured values can be transformed to form the measured values of the variables in the teaching satisfaction model. The specific matching relationship is shown in Table 2. For the convenience of recording, the secondary indicators of Table 1 are respectively coded as A11, A12; B11, B22, B22, B23; …; D41, D42.

4. JAPANESE TEACHING QUALITY SATISFACTION MODEL ASSOCIATION RULES IN THE CLOUD PLATFORM ENVIRONMENT

4.1 Teaching Quality Satisfaction Model Association Rule Discovery

On the basis of the teaching quality satisfaction model and the teaching quality satisfaction measurement index system, a student's evaluation of the teacher's curriculum constitutes a data record. Data on the student's grade, the teacher, and the course are added to the original information. In the original information, the data of student's grade information, teacher information and course information are added. Based on these data, the rule patterns of expected discovery are divided into three categories: teacher information and teaching quality assessment association rules (teaching quality and teaching satisfaction), student information and teaching quality association rules (student expectations and teaching satisfaction, student expectations with the learning process) and the quality of teaching the course contents (learning process and quality of teaching).

On the basis of the above-mentioned rules model, by describing the teacher's teaching, research, and practical ability, ascertaining the strengths and weaknesses of the students' performance, and using the social science, humanities and science and technology contents of the course as conditions, the dependence of the above rules is analyzed.

4.2 Teaching Quality Satisfaction Experiment

4.2.1 Data Preprocessing

For this experiment 500 valid classroom teaching quality assessment responses were collected from students at Hunan City College, comprising basic data for one semester. After the evaluation scores were collected, 10 individual indicators were combined with effective teaching characteristics at home and abroad. The evaluation indicators include the overall evaluation of classroom teaching quality, teaching attitude, teaching content, teaching methods, and teaching impacts.

We selected a semester teaching evaluation form and basic information of relevant teachers for the data collection, established a basic information database for teachers and a teacher

Table 3 Hardware configuration of each node.

CPU	Memory	Hard Disk	Network Card
Intel Core i5	2G	500G	Gigabit Ethernet NIC

Table 4 Basic settings of each node.

User Name	Host Name	IP	Gateway
Hadoop	Master	192.168.32.10	192.168.32.1
Hadoop	Slaver1	192.168.32.11	192.168.32.1
Hadoop	Slaver2	192.168.32.12	192.168.32.1
Hadoop	Slaver3	192.168.32.13	192.168.32.1
Hadoop	Slaver4	192.168.32.14	192.168.32.1

Table 5 Distribution Table of Association Rules for Satisfaction with Course Information and Teaching Quality

Rule	Course category	Teaching attitude	Attitude 1	Attitude 2	teaching method	Method 1	Method 2	Method 3
1	A	A	-	-	-	-	-	-
2	A	-	-	-	-	-	-	-
3	A	-	-	-	-	-	-	-
4	A	-	A	-	-	-	-	-
5	A	-	-	A	-	-	-	-
6	B	-	-	A	-	-	-	-
7	A	-	-	-	-	-	A	-
8	A	-	-	-	-	-	-	-
9	C	-	-	-	-	-	-	-
10	A	-	-	-	-	-	-	-
11	C	-	-	-	-	-	-	-
12	A	-	-	-	-	-	-	-

evaluation database, and built a Japanese teaching evaluation database accordingly. Then the data in the database was pre-discretized to obtain a new teaching evaluation data table. According to the characteristics of the original data, in order to facilitate the processing, the total score [0, 100] was divided into three intervals [0, 80), [80, 90), [90, 100], respectively denoted by C, B, A. The teaching attitude [0, 20] was divided into two intervals [0, 18), [18, 20], denoted by B, A respectively. The teaching attitude 1- [0,10] was divided into two intervals [0,9), and [9,10] were represented by B and A respectively. Divide the teaching attitude two [0, 10] into two intervals [0, 9), [9, 10], denoted by B, A respectively. Divide the teaching method [0, 30] into two intervals [0, 27), [27, 30], denoted by B, A respectively. The teaching method 1[0,10] was divided into two intervals [0,9), and [9,10] were represented by B and A respectively. The teaching method 2[0,10] was divided into two intervals [0,9), [9,10], which were denoted by B and A respectively. The teaching method 3[0,10] was divided into two intervals [0,9), [9,10], which were denoted by B and A respectively. The teaching effect [0, 20] was divided into two intervals [0, 18), [18, 20], which were denoted by B, A respectively. Divide the teaching effect 1[0,10] into two intervals [0,9), [9,10] were denoted by B, A respectively. Divide the teaching effect 2[0,10] into two intervals [0,9), [9,10], denoted by B, A respectively. Divide the teaching content [0, 30] into two intervals [0, 27), [27, 30], denoted by B, A respectively. The teaching content 1[0,10] was divided into two intervals [0,9), and [9,10] were represented by B and A respectively. The teaching content 2[0,10] was divided into two intervals [0,9), [9,10], which were denoted by B and A respectively. Divide the teaching content 3[0,10] into two intervals [0,9), [9,10], denoted by B, A respectively.

4.2.2 Experiment Process

Five computers were selected to build a Hadoop platform: Ubuntu Linux 10.10 for the computer system, Hadoop 1.0.3 for Hadoop, one machine for Master and Job-Tracker service node, hardware configuration and basic settings of five computers as shown in Table 3 and Table 4.

We use five PCs to complete the cluster building multi-node, multi-node distributed environment is the real environment of Hadoop framework, the basic conditions required for its deployment and the three configuration files modified are conf/core-site. xml, conf/mapred-site. xml and conf/hdfs-site. xml. Based on the above data, algorithm and experimental environment, the operation produced relevant results.

4.2.3 Analysis of Experimental Result

Because of space limitations, the results of the course information and satisfaction with Japanese teaching quality are shown in Table 5.

Based on the systematic analysis of the other three experimental results, the revised Japanese teaching satisfaction model is obtained as shown in Figure 3.

Comparing the model in Fig. 3 with the model in Fig. 2, we find that: firstly, the influence of Japanese teaching process on teaching complaints is significant and teaching loyalty cannot

Table 5 Distribution Table of Association Rules for Satisfaction of Course Information and Teaching Quality (Continuation Table).

teaching effectiveness	Effect 1	Effect 2	Content of courses	Content 1	Content 2	Content 3	Support degree	Confidence level
-	-	-	-	-	-	-	0.4	0.7
A	-	-	-	-	-	-	0.4	0.7
-	-	-	A	-	-	-	0.4	0.7
-	-	-	-	-	-	-	0.4	0.7
-	-	-	-	-	-	-	0.43	0.75
-	-	-	-	-	-	-	0.3	0.6
-	-	-	-	-	-	-	0.4	0.7
-	A	-	-	-	-	-	0.43	0.75
-	-	B	-	-	-	-	0.43	0.75
-	-	-	-	A	-	-	0.43	0.83
-	-	-	-	-	A	-	0.4	0.8
-	-	-	-	-	-	A	0.4	0.7

Table 6 Description of Association Rules for Satisfaction with Course Information and Teaching Quality

Rule 1: The course is easy and the teaching attitude is good
Rule 2: The course is easy and the teaching effect is good
Rule 3: The course is easy and the content is good
Rule 4: The course is easy and the teaching attitude is rigorous
Rule 5: Courses are easy to learn; teaching attitudes are open to suggestions
Rule 6: Course difficulty is medium, teaching attitude listens to opinions
Rule 7: The course is difficult and easy, and the teaching method enlightens the thinking
Rule 8: The course is easy and the teaching effect is active
Rule 9: The course is very difficult and the teaching effect is to master knowledge
Rule 10: The course is easy and the content of the course is rich
Rule 11: The course is very difficult and the teaching content is very important
Rule 12: The course is easy and the content is appropriate

Figure 3 Japanese teaching quality satisfaction model based on association rules

be formed, which may be due to the influence of operability and professionalization; secondly, the quality of teaching does not affect the quality satisfaction; that is, the quality of Japanese teaching is not the focus of education, which shows that Japanese education in our school focuses on teaching.

Based on the Fig.3, we obtain the following insights and suggestions:

(1) From the perspective of teachers, the teaching quality is satisfactory. Students have high expectations of teachers' professional titles. There is a significant correlation between professional titles and teaching attitudes 2 and teaching effect 2. It shows that teachers with high qualifications can listen to students' opinions, actively improve, prepare adequately for class and are more accountable to students. Therefore, teachers with higher professional titles are also more effective in Japanese teaching.

(2) From the perspective of curriculum, the teaching quality is satisfactory. There is a significant correlation between non-science and engineering courses and teaching attitude, teaching attitude 1, teaching attitude 2, teaching method 2, teaching effect, teaching effect 1, teaching effect 2, teaching content 1, teaching content 2, teaching content 3; engineering secondary courses and teaching attitude 2. There is a significant correlation between the high score of evaluation, which shows that the students of this course have a strong acceptance of and a relatively positive attitude towards the evaluation of teaching quality. At the same time, we also notice that the students of the humanities that have a relatively high evaluation of the teachers who

are fully prepared for the class, which also shows that the students in this course have a high degree of dependence on the teachers.

(3) According to the students' feedback, there is a significant correlation between the students with good academic performance and the students giving high scores for teaching quality and the students with average academic performance and the total score of teaching quality, which indicates that the students with good academic performance are more specific when evaluating teaching quality, and the students with medium academic performance have a general attitude to evaluating teaching quality. The students with good academic performance have a general attitude towards teaching and learning. There are significant correlative rules in the evaluation of teaching methods, teaching effects and teaching contents, which show that learning attitude has an important influence on the students' evaluation of teaching quality. Therefore, it is suggested that when educating our students, we should pay attention to improving students' performance, adopt various teaching methods to increase students' interest in the curriculum, and strive to create a learning atmosphere of pioneering excellence and improve the quality of teaching practices.

5. CONCLUSIONS AND FUTURE WORK

This paper proposes a Japanese teaching quality satisfaction model based on the satisfaction model. By constructing a reasonable evaluation index, it focuses on the specific factors that affect students' evaluation of teachers' teaching satisfaction. Combining with the current rising cloud computing, it explores the improved Apriori algorithm based on Hadoop platform, and obtains information about students, teachers and curriculum. The correlation between course content and satisfaction with teaching quality can act as a guide to drive improvement in teaching practice.

The next step is to collect different kinds of data and explore the specific factors that affect teaching in a wider range of contexts. Hence, we will explore an effective evaluation index system for Japanese teaching which is suitable for different stages, colleges and disciplines to improve the teaching level.

REFERENCES

1. Liu Qi, Zhang Yingzi. Study on the Construction of Evaluation Index System of Higher Vocational Students' Satisfaction [J]. New West, 2009 (14): 190–191.
2. Brief Caiyun. Research on the Index System of Student Satisfaction Evaluation in Higher Vocational Colleges [J]. Liaoning Education Research, 2008 (08): 61–64.
3. Han Yuzhi. Comment on American College Students' Satisfaction Survey Method [J]. Comparative Education Research, 2006 (06): 61–64.
4. Lu Jingjing. Teaching Evaluation System Based on Data Mining [D]. Nanjing: Hehai University, 2007.
5. Chen Tao, Hu Xueshan, Chen Xiumei. Analysis of Teaching Quality Evaluation System Based on Data Mining [J]. Progress of Computer Technology and Application, 2010, 436–440.
6. Li Shuping. Research on Data Mining-based Vocational English Curriculum Design [J]. Journal of Jixi University, 2013, 13 (5): 65–67.
7. Xu Zhangyan, Liu Meiling, Zhang Shichao, et al. Three optimization methods of Apriori algorithm [J]. Computer Engineering and Application, 2004, 36:190–192.
8. Liu Huating, Guo Renxiang, Jiang Hao. Research and Improvement of Apriori Algorithms for Association Rule Mining [J]. Computer Applications and Software, 2009, 26 (1): 146–149.
9. Zhang Zhen, Hu Xueshan, Zhang Yaping. Application of Data Mining in Classroom Teaching Quality Evaluation System of Colleges and Universities [J]. Computer Development and Application, 2007 (112): 41–42.
10. Peng Renjie. Research on the construction of teaching resource sharing system based on cloud computing [J]. Fujian Computer, 2016 (01): 145,146 + 156.
11. Dai Xiuzhen. Design scheme of teaching resource sharing platform based on cloud computing [J]. Wireless Interconnection Technology, 2015 (23): 80–81.
12. Liu Jianhua, Luo Xijing, Sun Yu. Construction of "micro-course" teaching resources sharing platform based on cloud computing [J]. China Vocational and Technical Education, 2015 (11): 70–73.
13. Qiu Chunhong. Construction of teaching resource sharing platform based on GAE cloud computing [J]. Intelligent Computer and Application, 2014 (02): 106–108
14. Li Songbo. Research on Teaching Resource Platform Based on Cloud Computing [J]. Contemporary Vocational Education, 2012 (08): 28–30+21.