Classified Evaluation Model of Online Teaching Quality in Colleges and Universities Based on Mobile Terminal

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Abstract. At the moment, only students' academic achievements or questionnaire statistics are used to assess teaching quality. Its accuracy and efficiency are limited when applied to online evaluation of teaching quality. To address the aforementioned issues, this work investigates and develops an online teaching quality categorization evaluation model based on a mobile terminal. The crawler crawls the necessary data after collecting the evaluation of teaching excellence data on the mobile terminal. The online teaching quality categorization and assessment dimension is built based on data climbing, allowing for multi-dimensional teaching quality evaluation. On this basis, the teaching quality classification and evaluation index system is constructed. An adaptive variant genetic algorithm was used to improve the BP neural network and establish a classification and model for assessing teaching quality. The model test results show that the average evaluation accuracy of the model is 88.16%, and the model has good evaluation efficiency and stability.

Keywords: Mobile terminal · Teaching quality · Classification evaluation · Model construction · BP neural network

1 Introduction

In the process of development, the demand for talents is increasing day by day. High-quality talents reserve is related to a country's comprehensive competitiveness in the world to a certain extent. The impact of science and technology on higher education is increasingly far-reaching. For example, with the popularization of the Internet, teaching tools have become diversified. Educators and learners no longer simply refer to teachers and students, but have become more flexible in their objects and content. In this learning environment, both educators and students must adapt to and learn new technologies. In order to promote the development of modern higher education and integrate scientific and technological means into it, we must carry out modern reforms in education contents, means and methods so as to effectively improve the quality of education. Online teaching is the main way to ensure the smooth teaching plan in university. Therefore, online teaching quality evaluation is very important for college teaching research [1].

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The evaluation of teaching quality is an important way to reflect whether the teaching goal is realized or not, and whether the curriculum is valuable or not. The existing problems of traditional teaching quality evaluation methods are mainly embodied in the following aspects: emphasizing management, ignoring the inadequacy of teaching process and evaluation index, pursuing quantity excessively, and imperfect evaluation subject. Compared with the statistical evaluation method of questionnaire, the reliability of the evaluation method of AHP and fuzzy hierarchy is relatively improved. Reference [2] method using the concept of student-centered, this paper analyzes the three indexes of students' learning input, learning support and learning effect, and puts forward a scientific and reasonable evaluation system of experimental teaching quality by combining learning motivation, refining resources support and incorporating multi-dimensional perspective into the evaluation path. Reference [3]. After controlling for the characteristics of students, instructors, and schools, the difference between anticipated values of students' accomplishments and average values of classes may be viewed as the net influence of teachers' instruction on students' academic progress. The influence of teachers' teaching quality is represented by adding the average values of these residuals at the class level, and the assessment results of teachers' teaching quality are derived.

When employing mobile terminals for effective online teaching, controlling instructor teaching quality becomes more challenging, and there are several constraints in the actual application of existing teaching quality evaluation methodologies [4]. Therefore, this paper will study and build a model of online teaching quality classification and evaluation based on mobile terminal to solve the operational problems of online teaching quality evaluation and evaluation system, and continuously improve online teaching quality through quality evaluation, stimulate teachers' enthusiasm and responsibility.

2 Construction of Classified Evaluation Model of Online Teaching Quality in Colleges and Universities Based on Mobile Terminal

2.1 Access to Online Teaching Data by Mobile Terminals

Teachers' teaching quality is finally embodied by students' performance and feedback, but teachers can't get students' feedback on teaching process accurately and timely when teaching online. Therefore, this paper uses the corresponding function modules of mobile data terminal to collect the data of students in real time.

Students use mobile terminals to log on to the online teaching platform of colleges and universities, and then enter the corresponding teaching port. When the teaching activity begins, the backstage of the online teaching platform stores all the data from the authorized mobile terminal into the corresponding database. The data collected by mobile terminals usually include the students' facial expressions, attendance, enthusiasm for class and feedback after class. These data are often cluttered and unordered, and this paper uses distributed crawlers to obtain data that will ultimately be used to classify and evaluate teaching quality [5].

The crawler searches for data through the mobile terminal identification code stored in the background and the corresponding student ID, reads the contents of a data table from a certain data table in the database, finds the link addresses of other data tables that

exist in the data table, then jumps to the next linked data table and continues the search until all the data tables in the online teaching platform database are grabbed. According to the breadth priority strategy, the priority of layer 1 is the highest, and then according to the depth of the layers, the priority is: layer 2, layer 3, layer 4, layer 5. Because the breadth-first fetching strategy is decided according to the level of the target link, it does not need to record the branch node of the last crawl, which reduces the control difficulty. This paper introduces a Bayesian classifier to define the type and direction of crawler data acquisition, which is not suitable for teaching quality classification and evaluation.

For category dc in each data type, a Bayesian classifier can be constructed to compute the probability dc of data table e belonging to category $P(dc|e)$. Crawling allows you to pick a list of interesting analogies for $d\dot{c}$. Each data table that is crawled down is given a correlation score [6]:

$$R(e) = \sum_{dc \in d\dot{c}} P(dc|e) \tag{1}$$

There are two different strategies for qualifying a reptile. In the soft-qualified strategy, the crawler uses the score $R(e)$ of e for each crawled table as a priori value for all unaccessed table links extracted from the e, which are then enqueued with priority. In the hard-qualified strategy, when the data table e is crawled down, the classifier first finds the leaf node $d\,\widehat{c}\,(e)$, which is most likely to be the e of the category:

$$d\,\widehat{c}\,(e) = \arg\max P(dc|e) \tag{2}$$

When the above requirement is met, the crawled data table is added to the queue, otherwise it will be dropped. The maximum and minimum normalized function, which is used after the data of online teaching quality is crawled, can transform the data linearly without losing the original meaning and information. The normalized formula for the maximum and minimum method is as follows [7]:

$$P' = \frac{P - P_{\min}}{P_{\max} - P_{\min}} \tag{3}$$

P' is the normalized data of teaching quality evaluation, P is the collected raw data, $P_{\min}$ is the minimum of the original data, and $P_{\max}$ is the minimum of the original data.

2.2 Establishment of Dimensions for Classified Evaluation of Online Teaching Quality in Colleges and Universities

Scientific classification is of great significance. It can summarize, consolidate and improve the results of comparison, systematize complex things, reveal the internal structure and proportional relationship of things, reveal the relations and differences between all kinds of things and things at all levels, improve the consciousness of scientific research, and provide clues for finding the law of development of things. In college and university online teaching quality categorization and evaluation, we should stimulate teachers' potential, innovate consciousness, promote teachers' comprehensive

ability, and make the evaluation methods and classification system more objective, real and reasonable.

Scientific classification must be carried out according to some attributes and relations of objects themselves. Because the objective things have many attributes, therefore, the classification standard is also many aspects. It is generally believed that there are two basic types of classification: phenomenal classification and essential classification. Online teaching has four main characteristics: dialogue, direct participation, support and control of the learning process, abbreviated as DISC characteristics. The characteristics of DISC vary with two variables, namely whether intentional learning is teacher-controlled or student-directed, and whether the learning activity is strictly defined or open. According to the two dimensions of online teaching (the openness of learning tasks and the degree of students' self-control), in the setting of teaching method indicators, the pertinence of design, the target of thinking, the vividness of language, the interaction of communication and other factors shall be integrated; in the setting of teaching content indicators, the transmission and integration of new knowledge, new ideas and new professional trends in teaching and education shall be integrated; in the setting of teaching effect indicators, the teaching effect shall not be measured simply by examination or by the department, but by the understanding and mastery of knowledge by students in multiple aspects [8].

Classified evaluation system must be able to promote teachers' teaching ability. Some of them belong to phenomenal classification and some to essential classification. The phenomenon is classified as follows: according to the level of online education, classification or purposes; according to the use of network courses for the classification of media; according to teaching information transmission and interaction patterns for classification. Among the essential classifications are: the classification from the perspective of teaching, the classification according to the openness of learning tasks and the degree of students' self-control, and the classification according to the relevance between learners in learning activities. Based on the teaching attitude, teaching method, teaching content and teaching effect, this paper constructs the online teaching quality classification and evaluation index system.

2.3 System of Online Teaching Quality Categorization and Evaluation Index Construction

When developing an online teaching quality assessment index system, teachers should consider not only teaching materials and techniques, but also students' learning effect and excitement. Effective integration of online and offline materials, not only in accordance with national standards, but also in accordance with local features of teaching resources, resulting in a more content-rich course.

Among them, teacher literacy can have a direct and key impact on the quality of teaching, teachers need to assume a diverse identity. At the same time, teachers need to use a variety of management tools to check students' practice results, more flexible and more diverse teaching methods, methods and means, so as to achieve better teaching results. The influence of teachers' accomplishment on teaching quality does not interfere with the teaching mode. In the practice of online teaching, we should not only accomplish the teaching task smoothly and achieve the given teaching goal, but also guarantee the

teaching effect. In online teaching, teachers should increase or decrease the teaching content of the platform, so that students can keep up with the development of the subject, master cutting-edge knowledge. In fact, teaching process is the key factor that affects teaching quality.

This paper establishes the index system of online teaching quality classification and evaluation, as shown in Table 1 below [9], based on the dimensions of online teaching quality classification and evaluation and the factors that affect online quality of instruction.

Table 1. Classified Evaluation Index System of Online Teaching Quality

Categorical evaluation dimension	Grade I evaluation indicators	Secondary evaluation index
Teaching attitude D1	Teacher Teaching Literacy C1	Professional teaching ability C11
		Online Teaching Ability C12
		Professional background C13
	Instructional Reflection C2	Professional Teaching Thinking C21
		Basic teaching ideas C22
Teaching methods D2	Teaching Skills C3	Mobile terminal operating capacity C31
		Teaching Aid Data Collation Ability C32
	Lesson plan C4	Course Schedule Reasonable C41
	Diversity C5	Is it possible to use multiple teaching methods for teaching C51
Content D3	Rationality C6	Student Learning Speed C61
		Fit with teaching method C62
	Scientific C7	Most Difficult Points C71
		Grasp the front of science, introduce the latest trends and academic thought C72
		Theory with practice C73

(*continued*)

Table 1. (*continued*)

Categorical evaluation dimension	Grade I evaluation indicators	Secondary evaluation index
Teaching effect D4	Teaching Management C8	Ability to accurately monitor students' online learning C81
		Be able to combine daily teaching management with student performance assessment C82
	Teaching Feedback C9	Ensure that students are communicated with C91 after each class
		C92 Be able to improve the teaching process in real time based on teaching feedback

After establishing the classified evaluation model of online teaching quality shown in Table 1 above, according to the actual teaching experience, there are obvious differences in the weights of different evaluation indexes. Therefore, after constructing the online teaching quality classification evaluation system in Table 1, define the importance of the classification dimension of the classification evaluation is equal.

On the basis of the constructed indicators, the expert opinion form shall be formulated, and experts shall be invited again to assign the importance of the indicators to the Starr Relative Importance Table shown in Table 2 for each indicator item at the same level, and create the corresponding judgment matrix to obtain the weight of each indicator item [10].

Table 2. Stahl relative importance scale

Relative importance	Grade	Relative importance	Grade
A is as important as B	1	A and B are of equal importance	1
A is slightly more important than B	3	A is slightly less important than B	1/3
A is obviously more important than B	5	A is obviously less important than B	1/5
A is more important than B	7	A is less important than B	1/7
A is more important than B	9	A is less important than B	1/9
Intermediate value of adjacent degree between A and B	2, 4, 6, 8	Intermediate value of adjacent degree between A and B	1/2, 1/4, 1/6, 1/8

From the comparison table of relative importance, a judgment matrix can be obtained. For the evaluated judgment matrix, the next step is to sum the rank of each row of the judgment matrix, and then get the initial weight column vector. However, it is still not clear that this weight is a standard and meaningful weight. The consistency test of the judgment matrix must also be performed. The following is the test formula:

From the relative importance comparison table, a judgment matrix J can be obtained. For the evaluated judgment matrix J, the next step is to sum the rank of each row of the judgment matrix, and then get the initial weight column vector. However, it is still not clear that this weight is a standard and meaningful weight, and the consistency test of the judgment matrix needs to be conducted. The formula for the test is as follows:

$$CR = CI/RI \tag{4}$$

Among them, CI represents the consistency index, and $\lambda_{\max}$ is used to get the maximum eigenvalue of the judgment matrix, and n represents the order of the square matrix. RI represents the average random consistency index, and its values can be found according to the corresponding table. In the case of $CR \leq 0.1$, it indicates that the judgment matrix passes the consistency test and has consistency, whereas in the case of $CR > 0.1$, it indicates that there is a big deviation in the judgment matrix and the score needs to be modified until it passes the consistency test.

2.4 Construction of Classified Evaluation Model for Online Teaching Quality

When there are enough samples to train, the network may adjust the proper weights and then forecast the teaching quality assessment outcomes based on the sample data. Because the standard BP neural network is prone to falling into the local minimum and has a poor convergence speed, this research uses an adaptive mutation genetic method to enhance the BP neural network. The following are the processes for developing the BP neural network model based on the adaptive mutation genetic algorithm:

(1) The design of the input layer: according to the secondary indicators in the classification and evaluation system of online teaching quality of colleges and universities established above
(2) Design of output layer

The number of output neurons is one because the evaluation results are used as the BP network outputs in this paper.

(3) Design of hidden layers

The more hidden layers inside a neural network, based on its structure and training process, the more difficult the BP neural network is. Kosmogorov's theory selects the BP network with just one hidden layer structure.

(4) Determination of the number of neurons in the hidden layer

The most appropriate number of neurons in the hidden layer is determined by empirical formula and several experiments (the quality of network convergence performance). The empirical formula selected in this paper is as follows:

$$l = \sqrt{m+n} + \alpha \tag{5}$$

l is the number of neurons in hidden layer, m is the number of neurons in input layer, n is the number of neurons in output layer, and α is the constant between 1 and 10. The calculation suggests that the number of neurons in the hidden layer should be between 6 and 14. The learning error and fitness functions are shown below.

$$\begin{cases} E = 0.5 \sum_{k=1}^{p} \sum_{j=1}^{l} \left(i_j^k - o_j^k \right) \\ fit = E^{-1} \end{cases} \tag{6}$$

Among them, i_j^k and o_j^k are input and output vectors of neural network, E is learning error of neural network, fit is fitness function. Evaluate the quality of online teaching in colleges and universities according to the flow chart shown in Fig. 1.

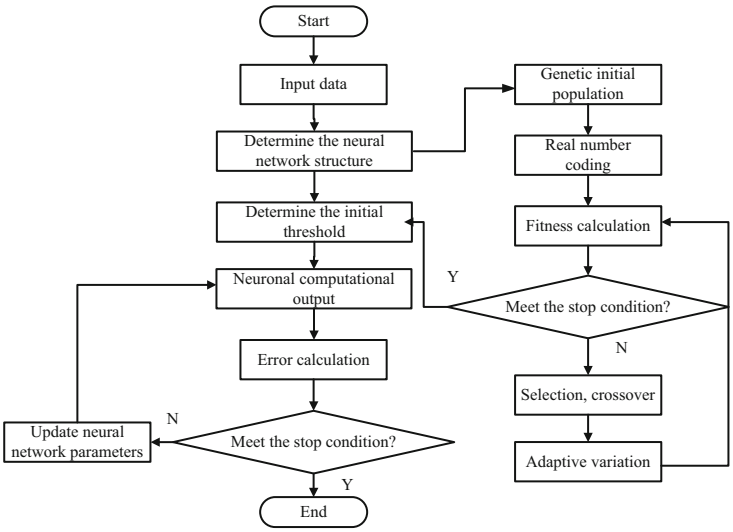

Fig. 1. AGA BP Model Evaluation Process

Among them, the iterative selection of genetic algorithm is roulette. Firstly, the fitness of neural network is calculated, and then the proportion of the fitness is calculated, which is the probability of the individual being selected in the selection process. After calculating the likelihood of each individual being chosen, the accumulated probability must be used to determine if the chosen individual may be passed on to the next generation. The genetic algorithm proposed in this paper crosses genetic operators by heuristic

crossover. According to the input data of neural network, the final evaluation results of online teaching quality are output according to the process in Fig. 1. So far, we've finished building the online teaching quality categorization assessment model based on mobile terminals.

3 Evaluation Model Test

3.1 Test Content and Preparation

This section will test the accuracy of the online teaching quality classification and evaluation model based on mobile terminals. AHP -based teaching quality evaluation model and fuzzy theory based teaching quality evaluation model are selected as the comparison, and the evaluation accuracy of the model is calculated.

There are 337 data sets in this experiment, of which 287 are training data sets and the remaining 50 are testing data sets. The dataset is evaluated using three teaching quality evaluation models. The evaluation results are compared with the simulation results. The accuracy of the model is obtained by calculating evaluation errors. Simultaneously, a statistical evaluation model is used to evaluate the time cost of each subset of data in distinct data sets in order to determine the model's processing efficiency.

3.2 Test Results

Table 3 below shows the comparison of the accuracy of online teaching quality evaluation using different teaching quality evaluation models.

Table 3. Comparison of Model Evaluation Accuracy/%

Groups	Classified Evaluation Model of Online Teaching Quality in Colleges and Universities Based on Mobile Terminal	Teaching Quality Evaluation Model Based on AHP	Teaching Quality Evaluation Model Based on Fuzzy Theory
1	87.18	81.38	79.51
2	89.03	84.63	74.30
3	88.36	79.45	70.55
4	87.92	81.51	78.57
5	89.34	79.52	78.04
6	86.89	79.96	80.22
7	89.55	80.23	81.35
8	88.21	82.64	77.77
9	87.12	80.27	78.63
10	87.97	76.91	79.69

From the analysis of the data in Table 3, we can see that under the same test standard, the evaluation accuracy of the online teaching quality evaluation model based on mobile terminal is higher than that based on AHP and fuzzy theory. Moreover, from the perspective of data change, the evaluation accuracy of online teaching quality classification model based on mobile terminal is more stable and not affected by data grouping and data differences. The accuracy scores of different evaluation models are 88.16%, 80.65% and 77.86%, respectively, according to the data in Table 3. The evaluation result is more accurate, the evaluation performance is more stable and the reliability is better.

Figure 2 below shows the comparison of time cost of online teaching quality evaluation using different teaching quality evaluation models.

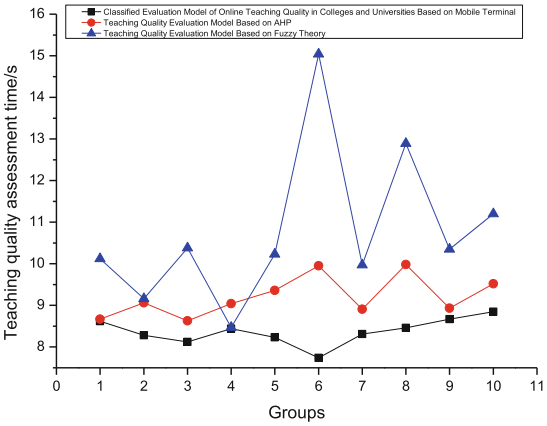

Fig. 2. Time cost comparison of teaching quality evaluation model

From the analysis in Fig. 2, the evaluation time cost of the model is significantly lower than that of the other two models when the data sets with different degrees of intra-group differences are evaluated. It shows that the evaluation model constructed in this paper can be applied to different evaluation links, and the evaluation efficiency is higher. The necessary data are crawled after collecting the teaching quality assessment data on the mobile terminal. We created an online teaching quality classification and evaluation dimension and a teaching quality classification and evaluation index system. We can improve our assessment of teaching quality. To summarize, the mobile terminal-based online teaching quality classification assessment model offers the benefits of accurate evaluation outcomes, high evaluation efficiency, and broad application.

4 Conclusion

In recent years, with the high speed popularization of computer and network, a new educational mode, namely online education, has emerged. Using online teaching can facilitate teachers to answer students' questions in time, teaching is not limited by time and space, can improve students' learning efficiency, promote the rapid formation of

students' knowledge system, and integrate as soon as possible. Under the current special background, there are obvious differences between the teaching activities carried out by mobile terminals and traditional teaching activities in universities. This paper constructs a classification and evaluation model of online teaching quality in colleges and universities based on mobile terminal, and verifies the feasibility and accuracy of the model.

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