

## Retraction

# Retracted: Research and Implementation of Intelligent Evaluation System of Teaching Quality in Universities Based on Artificial Intelligence Neural Network Model

### Mathematical Problems in Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### References

- [1] B. Gao, "Research and Implementation of Intelligent Evaluation System of Teaching Quality in Universities Based on Artificial Intelligence Neural Network Model," *Mathematical Problems in Engineering*, vol. 2022, Article ID 8224184, 10 pages, 2022.

## Research Article

# Research and Implementation of Intelligent Evaluation System of Teaching Quality in Universities Based on Artificial Intelligence Neural Network Model

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Scientific and objective education quality assessment is an important demand in the current education industry. Artificial intelligence empowering various industries has become an inevitable trend for future social development. The education quality assessment system combines big data and artificial intelligence technology. The system uses various human intelligence algorithms to analyze the collected image. Text data are related to teachers' teaching quality and can give objective results for education quality evaluation. This paper introduces the research and implementation methods of constructing the quantitative evaluation index system of university teachers' teaching quality and its quantitative processing method as well as the intelligent quantitative evaluation system of teaching quality and explores the technical ways to discover the effectiveness of measurable factors on the evaluation of teaching quality, and the obtained results have important practical significance for the scientific evaluation of teaching quality.

## 1. Introduction

In recent years, with the rise of deep learning, artificial intelligence has ushered in a new development boom. In the context of this new book, technologies in the fields of computer vision, speech recognition, and natural language processing have become increasingly mature, and many new products have emerged and been applied to various fields of social production and life. And the good economic and social benefits are generated by the combination of artificial intelligence and various production and life fields [1].

With the rapid development of higher education in China, the quality of teacher education has become a key concern for universities and education authorities at all levels [2]. The Ministry of Education (MOE) has also issued the Action Plan for Education Informatization 2.0 in conjunction with the requirements of the 13th Five-Year Plan for the development of national education and the arrangement of major strategic tasks [3].

The effectiveness of teachers' classroom teaching is the main factor affecting the quality of talents cultivated by universities, so carrying out a good evaluation of teachers' classroom teaching quality to help university teaching management to grasp teachers' situation, improve teaching, and implement teaching quality monitoring in a timely manner is one of the concrete and effective measures to improve teaching quality in universities [4]. There are many problems in the evaluation of education in Chinese universities, such as the excessive amount of basic work, difficulty in sharing and using information resources, difficulty in ensuring the objective authenticity of data and information, incomplete evaluation materials and information, cumbersome evaluation schemes, lack of integrated planning of evaluation, and insufficient basic construction [5].

The current quantitative evaluation methods of classroom teaching quality in higher education mainly include hierarchical analysis [6], one-way ANOVA [7], fuzzy comprehensive evaluation model [8], Markov chain method [9], artificial neural network method [10], data mining

method [11]. At present, modern quantitative statistical methods have been used in the evaluation of teaching quality in colleges and universities and have achieved certain effects to different degrees, but there are still many imperfections in these methods. In this paper, we introduce a strategy to construct a quantitative evaluation of teaching quality and use a neural network training method to intelligently evaluate the quantified evaluation index data.

Constructing an effective key factor set for teaching quality, the primary problem of quantitative evaluation of teaching quality is to collate, analyze, and summarize the main factors determining teachers' teaching quality from the standpoint of scientific evaluation and construct a key and effective set of factors for evaluating teaching quality by analyzing the correlation between factors and the degree of contribution of each factor to the results, so as to form a complete evaluation space describing teaching quality with the help of sufficient historical data and expert identification to verify the completeness and validity of this evaluation space [12].

This paper introduces the research and implementation methods of constructing the quantitative evaluation index system of teaching quality of university teachers and its quantitative processing method as well as the intelligent quantitative evaluation system of teaching quality and explores the technical ways to discover the effectiveness of measurable factors on the evaluation of teaching quality, and the obtained results have important practical significance for the scientific evaluation of teaching quality.

## 2. Related Work

Most of the existing intelligent teaching systems use technologies such as image recognition, AR/VR, speech recognition. They seldom use deep learning and only stay in the offline classroom, not integrated with the online learning after class [13]. Students learn various types of knowledge by talking to them through natural language on the basis of simulated teaching by human teachers, and the system is designed comprehensively in terms of interactive interfaces and processes. Tongji University proposed a multimodal student classroom behavior analysis system and method, which detect students' listening status and teachers' lectures through face recognition and microphone. Most of the current intelligent teaching systems focus on the teaching level within the classroom, but there are few educational products related to the two-day assessment of students' learning as well as teachers' teaching quality [14].

Zhou and Ji [15] proposed an interactive teaching system based on ZigBee technology, which is divided into teacher side and student side, and can realize the functions of class sign-in, answering questions, and anonymously evaluating teachers, etc. It has the characteristics of low cost and miniaturization, but the system lacks the specific design of teacher side, and the stability of ZigBee technology is poor, and the accuracy of various functions of the system cannot be guaranteed. Meanwhile, with the development of the network, online learning becoming more and more important in contemporary students' learning. Network online

education originated ten years ago. Yang et al. [16] proposed a model of an online teaching system supporting reversed classroom, based on the processing and integration of online teaching videos and the optimization of the presentation of answers to exercises, and the visualization of learning monitoring through the learning dynamic list to improve teaching efficiency. Li et al. [17] proposed a model of online course teaching system architecture, including modules such as resource library, intelligent inspection, and personalized design, but it is only at the theoretical level and lacks practical and operable design. Liu [18] designed an interactive online mathematics teaching system, which effectively improves students' learning interest through a number of functions such as instant feedback, intelligent judgment of geometric graphic, and gamification motivation, but the intelligent algorithm used in this system is relatively simple and cannot achieve automatic integration and analysis of feedback information. Online learning effect assessment [19, 20] summarized the advantages of MOOC teaching and proposed a hybrid teaching paradigm that combines online and offline classrooms to reshape the teaching organization and teaching-learning relationship. At present, most of the research on online and offline hybrid teaching and learning remains at the stage of theoretical analysis, but the research and design of the combined online and offline teaching and learning system are rare.

## 3. Related Technologies Used in Smart Education

With the continuous development of modern information technology and artificial intelligence technology, the degree of education informatization is also gradually increasing. Smart education is to borrow new Internet and artificial intelligence technologies to make education digital, networked, intelligent, and multimedia, showing the characteristics of openness, sharing, interaction, and collaboration.

**3.1. Computer Vision Technology.** Computer vision is the science of how to make computers "see" as humans do. This technology uses image capture devices such as cameras as "computer eyes" to acquire images or video information and uses computer vision algorithms to process the acquired images, videos, and other information. The processing of images by computer vision is usually divided into two categories: detection and recognition, and under each category, there are different branches of application.

The process of processing images or videos using deep learning methods in the field of computer vision is shown in Figure 1.

The process of deep learning for image or video processing mainly includes the steps of feature extraction, original algorithm model training, prediction image feature extraction, and analysis and prediction using the model.

Many current AI products interact with users through graphical interfaces, and as a technology for processing and analyzing images, computer vision technology is an essential research element in the field of AI. In smart education

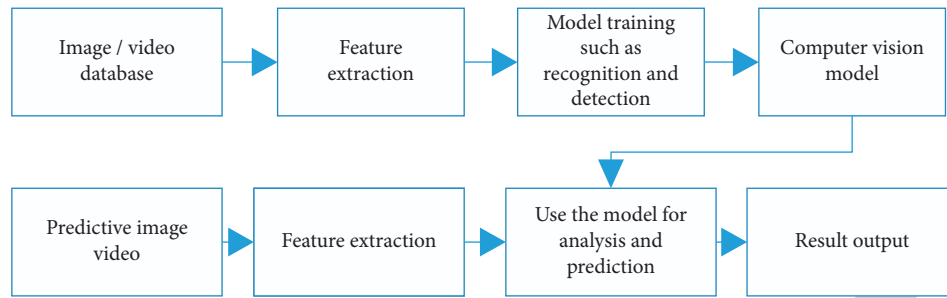


FIGURE 1: Image processing flow chart.

applications, computer vision technology can analyze and process images of teachers' lectures in classrooms, such as behavior analysis and study emotional analysis. The analysis results can effectively reflect the concentration level of students in the classroom, which can be used to evaluate the quality of education.

**3.2. Voice Recognition Technology.** Figuratively speaking, speech recognition is the science of making machines learn to "listen". This technology converts the audio signal captured by an audio capture device into a corresponding text or command. In recent years, with the development of artificial intelligence, especially deep learning technology, speech recognition technology has also been achieving breakthroughs. The accuracy rate of speech recognition in specific scenarios has exceeded 90%. At present, speech recognition technology is also the most landed and widely used technology in the field of artificial intelligence. The main process of speech recognition is shown in Figure 2.

The speech recognition process has more dictionaries and language model training than image processing. The main role of these 2 parts is to decode the speech features into natural language text for output after extracting the speech features using acoustic models.

In intelligent educational applications, speech recognition technology also has great potential. For example, it can be used to recognize and analyze the speech of teachers during lectures to determine the degree of civilized teaching or to analyze the interaction between teachers and students in the classroom.

**3.3. Natural Language Processing Technology.** Natural language processing is a technology that studies how to use natural human language to interact effectively with computers. The earliest work in natural language understanding was machine translation. In modern times, natural language processing is mainly based on machine learning, and after the emergence of deep learning, a series of excellent deep learning models such as RNN [21] and LSTM [22] have been used for natural language processing and achieved good results. The main process of natural language processing is shown in Figure 3.

The natural language processing process is similar to that of image and speech processing except for word vector coding. In fact, the biggest difference in processing different

forms of data lies in the data preprocessing process, that is, processing different types of data into a form that can be used by machines for feature extraction and training prediction.

Natural language processing technology can be used not only to analyze the evaluation of teachers by colleagues or students in teachers' social circles to assess teachers' teaching level but also for various applications to assist teachers in teachings, such as homework correction and paper grading.

## 4. Education Quality Assessment System Construction Plan

**4.1. Education Big Data.** The overall education data center adopts a layered architecture, and its architecture is shown in Figure 4.

The overall format of the big data center is  $M + N + 1$ , with  $N$  provincial subdata centers under the Education big data center, and each province will establish a provincial subdata center to collect and store education-related data in the province. Each provincial subdata center will collect and store  $M$  types of education data, including different types of education data from primary and secondary schools, higher education institutions, and training institutions. All data are collected and cleaned from the bottom and continuously aggregated upwards and finally stored in the education data center.

The data center can connect to the national higher education data platform through the API interface and obtain higher education data from the platform. At the same time, audio and video capture devices can be used to capture audio and video of teachers' teaching process offline or in real time [23]. In addition, online questionnaires can be used to survey teachers' teaching level, and the survey results data can be obtained through the API interface of the questionnaire website. Teachers' online social data can also be collected [24].

After data collection, the platform will process different types of data in batch or real time, using Hadoop or Spark framework for batch processing and storm or spark streaming framework for real-time processing.

After sorting and cleaning the data, the data center provides the data to the AI open-capability platform for AI algorithm training and education quality analysis through the API interface between the data center and the AI open-capability platform.

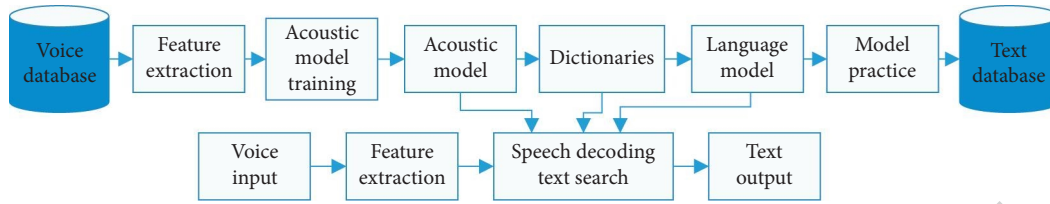


FIGURE 2: Flow chart of speech recognition.

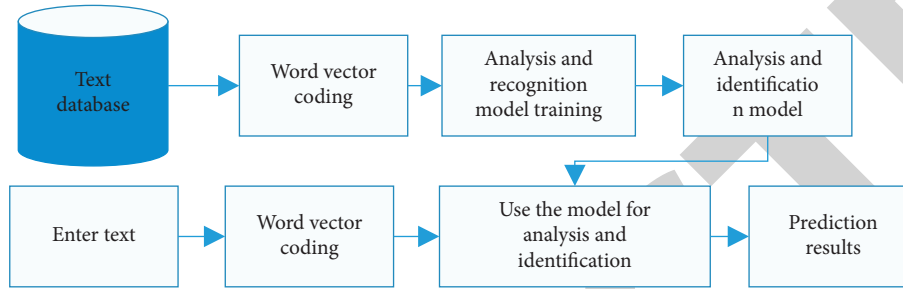


FIGURE 3: Natural language processing flow chart.

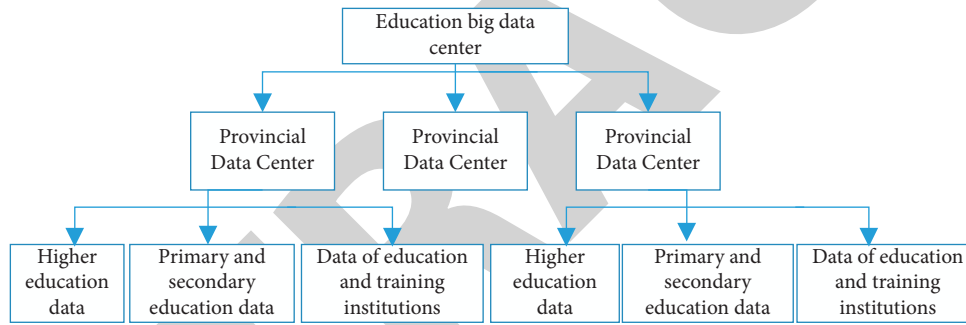


FIGURE 4: Overall structure of the education data center.

**4.2. Classroom Behavior Analysis.** The traditional way of evaluating the quality of education is for experts to observe classes and then make judgments based on their experience, which lacks evaluation criteria, and results vary greatly from one evaluator to another. Moreover, experts can only observe a small number of classes, which make it difficult for them to fully understand the teachers' teaching level, and if teachers prepare in advance, the assessment results may differ greatly from the teachers' actual daily teaching effect.

Since there are teachers and students in the classroom, classroom behavior analysis can be performed in 2 steps: locating the target and analyzing the target behavior. These two steps can be accomplished by computer vision and artificial intelligence technology, and the analysis process is fully automated without human intervention. The flow chart of classroom behavior analysis is shown in Figure 5.

Classroom behavior analysis can use online video files or video files from the database. The video files come from 2 cameras in the front and back of the classroom, the front camera is used to capture student data, and the back camera is used to capture teacher data. With the target detection algorithm, the classroom behavior analysis system can automatically identify people based on the differences in

teacher and student characteristics, while the classroom behavior analysis system can use the target analysis algorithm to analyze the behavior of different people statistically. Teachers' behaviors are divided into 5 types: lecture, board, pointing, leaning, and patrolling, and students' behaviors include 6 types: raising hands, writing, reading, discussing, listening, and standing. And based on the feature that deep learning algorithms are highly transferable, experts can also retrain the fine-tuned model to increase the detection behaviors if they think there is a new teacher or student behaviors that are helpful for analyzing the teacher's teaching quality.

Behavior recognition algorithms need to be used to analyze teacher and student behaviors after accurately locating their locations. Jal et al. [25] proposed a multitask deep learning model, which puts 2 tasks of pose estimation and behavior recognition in a deep learning network framework, and the framework diagram of this model is shown in Figure 6.

After feeding the static RGB images into the model, multitask CNN performs pose estimation and action recognition. The pose estimation is performed using a regression method, which utilizes a differentiable surtax to



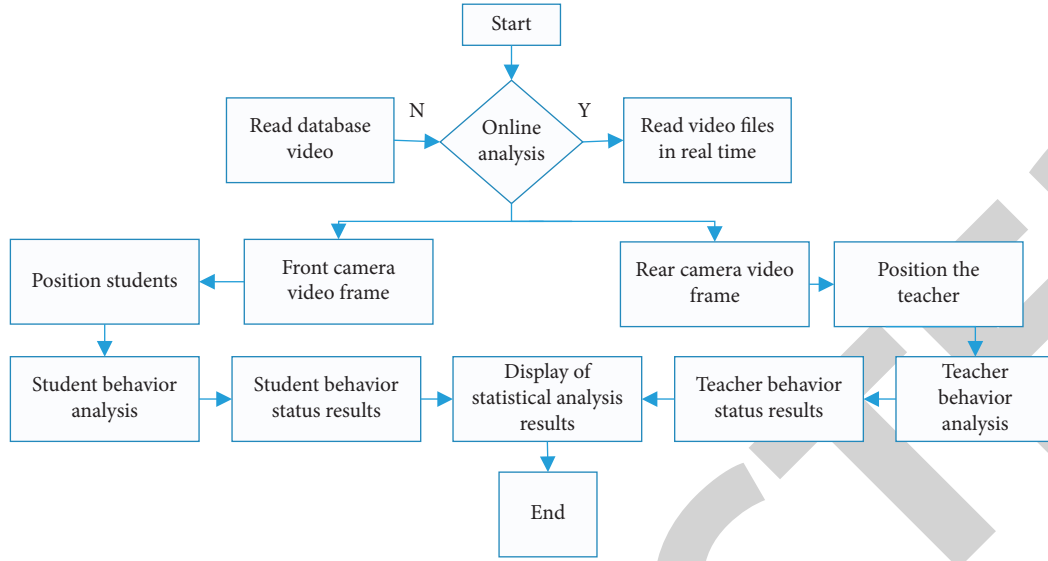


FIGURE 5: Flow chart of classroom behavior analysis.

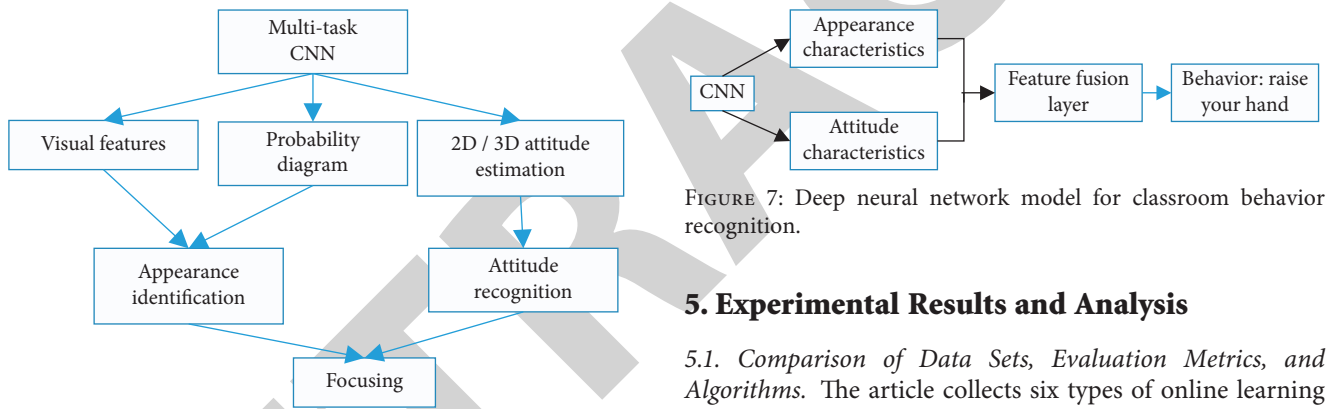


FIGURE 6: Multitask deep learning model.

combine 2D and 3D pose estimation. The action recognition is divided into 2 parts: pose-based recognition and appearance-based recognition. The results of the 2 tasks are combined for the final behavior recognition.

An important idea of this method is to use the mutual reinforcement between multiple tasks to improve the accuracy of the final task. Based on this idea and the scenario of classroom behavior analysis, the combined multitask approach can also be used in classroom behavior recognition. When recognizing teacher and student behaviors, both gesture and appearance features of the target are beneficial for behavior recognition, and the two features can be combined to achieve a mutually beneficial complementary effect. For example, students' gestures of raising their hands and writing are obviously different and can be effectively recognized by combining appearance features; students' gestures of writing and reading are very similar, so it is difficult to distinguish them by gesture features only, and can be effectively distinguished by adding appearance features. The deep neural network model for classroom behavior recognition based on this idea is shown in Figure 7.

FIGURE 7: Deep neural network model for classroom behavior recognition.

## 5. Experimental Results and Analysis

**5.1. Comparison of Data Sets, Evaluation Metrics, and Algorithms.** The article collects six types of online learning behavior data from the open data interface provided by the classplay.com platform: login time, browsing teaching resources, forum data, online notes, postclass homework completion, and online test score. In view of the characteristics of the cooperation between the Play.com platform and institutions, the article uses the users' real final exam score and the evaluation of class teachers as the class criteria for comprehensive evaluation and adopts the following classification:

$$G = g \times 70\% + e \times 30\%, \quad (1)$$

where  $G$  represents the real grade of the students' final exam,  $e$  represents the grade assessed by the teacher of the class, and  $G$  represents the overall assessment grade.

In addition, combined with the data of users' online learning behaviors provided by the PlayClass platform, 110 users were targeted as the experimental group, and their emotions were analyzed, and the categories and time of microexpressions during online learning were counted. In this study, the article uses a scoring format, with 1 point for doubt and happiness, 0 point for bland and angry, and -1 point for fear and sadness, and defines different ratios of the number of expressions and category combinations to obtain a 4-dimensional score for each user's emotion.

Accuracy rate  $P$  was adopted as the evaluation index for the student performance prediction experiment. The accuracy rate is the percentage of all categorized students who match the categorization result. It is defined as

$$P = \frac{\text{No. of students with correct classification}}{\text{No. of students actually classified}} \times 100\%. \quad (2)$$

To measure the relationship between the temporal regularity of students' online learning and their learning effectiveness, the article uses Spearman's correlation coefficient for quantitative description. Spearman's correlation coefficient was used to calculate the correlation and to determine the relationship. The formula is as follows:

$$r_s = 1 - \frac{6 \times \sum d_i}{n(n^2 - 1)}, \quad (3)$$

where  $d_i = \text{rg}(X_i) - \text{rg}(Y_i)$  is the rank difference between the achievement ranking grade and the time difference ranking grade. The Pearson correlation coefficient between ranking variables is used to calculate, defined by the following formula:

$$r_s = \rho_{\text{rg}_X, \text{rg}_Y} = \frac{\text{cov}(\text{rg}_X, \text{rg}_Y)}{\sigma_{\text{rg}_X} \sigma_{\text{rg}_Y}}, \quad (4)$$

where  $\text{rg}_X$  denotes the rank order of true performance,  $\text{rg}_Y$  denotes the rank order of time difference,  $\text{cov}(\text{rg}_X, \text{rg}_Y)$  denotes the covariance of rank variables, and  $\sigma_{\text{rg}_X}, \sigma_{\text{rg}_Y}$  denotes the standard deviation of rank variables.

In this paper, we use classroom test videos to test and compare various target detection models with face recognition algorithms, and the results are listed in Table 1. The target detection module of Fast R-CNN and the face detection module of FaceNet in the offline system designed in this paper both achieved the highest recognition accuracy.

**5.2. Teaching Assessment.** After obtaining the maximum, minimum, and average values of each user's online learning interval, as well as the truncated average of the extremes at both ends removed, each subject was ranked for each of the four values. The real assessment score of the users is also ranked.

The actual entropy function of the user is calculated, and the corresponding ranking is given, and then, the actual entropy and the ranking Spearman's correlation scatter plot are drawn according to the actual ranking of the user's performance, as shown in Figure 8.

Spearman's correlation can be calculated as having significant positive correlation properties. Intuitively, users with more regular learning time cycles are more self-disciplined, which is manifested in learning, as users periodically review what they have learned and perform better on performance measures. Combining the above-mentioned time difference rank correlation and the rank correlation of the actual entropy function, the article adds the score of the actual entropy function as the dimension of temporal regularity into the model and performs the correlation training of the BP neural network, which finally increases the correct

rate of the test set to 74.79% and achieves the purpose of enhancing the prediction accuracy of the model by fully mining the learning log records of online users.

Based on the analysis of microexpressions of users when they performed online learning, the number and proportion of appearances of various types of expressions were counted, and the emotion score of 101 users in four dimensions was obtained in the experiment.

Processed emotional dimension data were analyzed by  $K$ -means clustering to the emotional classification results. The  $K$ -means clustering results showed that the best clustering results were obtained when  $K=3$ , that is, the measurement function value of each point of each type of center of mass was the smallest. Based on the sentiment data, the sentiment attributes of 101 users were classified into three categories. By processing the similarity matrices, the users are swapped in the ranks of the matrices, and the users who are clustered in the same class as above are swapped together. By doing so, the users of the 3 classes are clustered together, and the visualization of the heat map will show 3 diagonal blocks on the diagonal, which indicates that the clustering effect is obvious. The heat maps of the similarity matrix after clustering are shown in Figure 9.

Students with higher learning achievement in these 3 categories, that is, those achievement categories are labeled as level 1, are obtained, and their common online learning characteristics are extracted.

The function of two-way feedback of classroom quality based on classroom information collected from classroom terminals is implemented by the processing unit of the cloud server and its subunits. The attendance analysis and feedback subunit retrieve and use the trained face segmentation model to count the number of faces in the classroom images to realize the classroom headcount and calculate the attendance rate at the same time. The trained face detection model is used to recognize and match the segmented faces based on the student face information in the data storage module to achieve intelligent student's attendance, as shown in Figure 10. And the headcount result, attendance rate, and student's attendance result are updated to the student's attendance data in the data storage module; the attendance rate-time line graph based on the student's attendance data in the data storage module is drawn; a preliminary assessment of the teacher's teaching quality based on the attendance rate is made; and the line graph and the evaluation results to the teacher feedback information in the data storage module are updated.

Based on the phenomenon that the faces of students with their heads down are not easily recognized, the face segmentation model is used to detect the number of faces in each video frame in the data storage module and calculate the listening rate, and the listening rate-class time graph is drawn based on the listening rate, as shown in Figure 11. Based on the calculated face position coordinates, a scatter plot of the location of students (i.e., faces) in the two-dimensional coordinate system is drawn, as shown in Figure 12, and the listening rate results, the curve, and

TABLE 1: Average detection effect on the test video (%).

Model name	Test data set	
	Accuracy of behavior recognition	Data face recognition accuracy
SSD mobilenet v1	52.29	82.29
SSD mobilenet v2	56.33	86.33
SSD litmobilenet v1	57.1	87.1
SSD inception v2	60.35	90.35
FasterR-CNN Inc-V2	65.8	85.8
Rcnn resnet 101	74.38	84.38
Faster R-CNN	82.4	85.4
Racenet	—	97.99

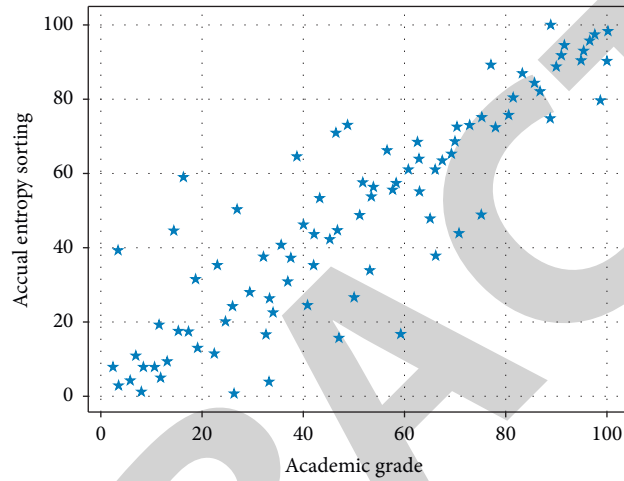


FIGURE 8: Scatter plot of the actual entropy Spearman's correlation.

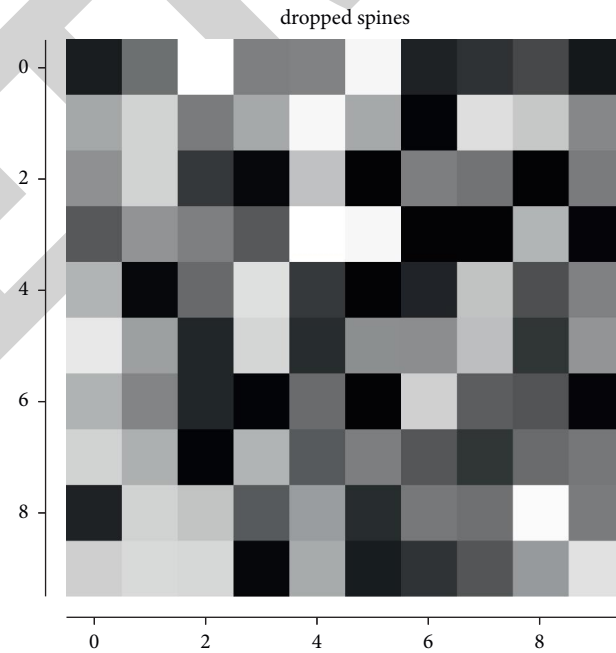


FIGURE 9: Heat map visualization of the similarity matrix after clustering.

the scatter plot are updated to the listening rate data and teacher feedback information in the data storage module, respectively [26].

The classroom behavior analysis and feedback subunit retrieve and use the trained image target detection model to detect classroom behaviors (e.g., students raising their





FIGURE 10: Classroom intelligent face detection results graph.

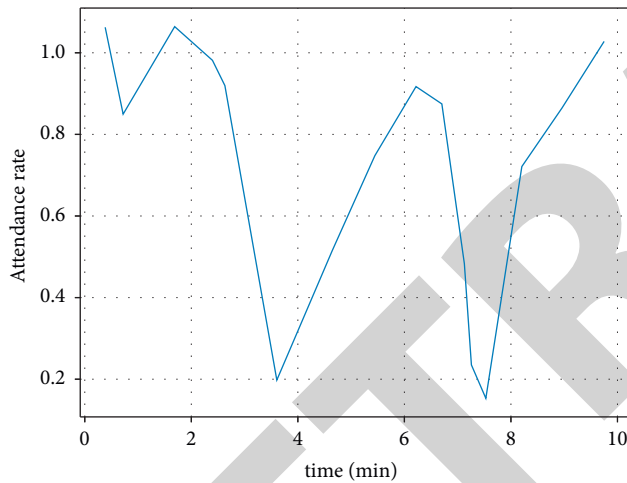


FIGURE 11: Listening rate-classroom time curve.

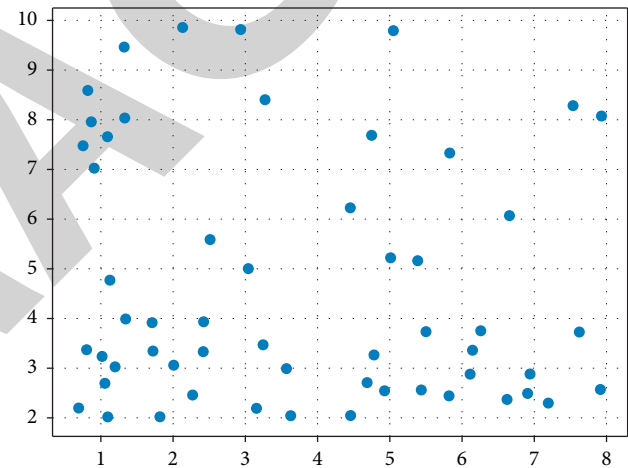


FIGURE 13: Seating distribution of various types of students.

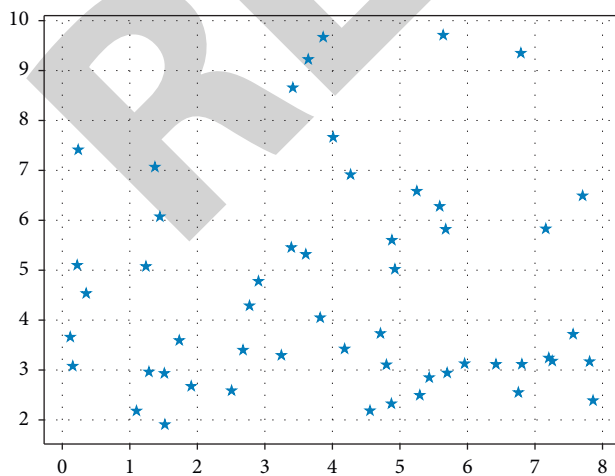


FIGURE 12: Distribution of students listening to the lecture.

hands, standing, sleeping, teacher interaction) in the video frame images in the data storage module, identify student locations and count classroom behavior types and times using the face segmentation and detection model, update student identities to classroom behavior data and student feedback information, and update the locations of students with classroom. The student identity is updated to the classroom behavior data and student feedback, and the location of students with classroom behavior and the type and number of behaviors are updated to the classroom behavior data.

The classroom seat analysis and feedback subunit use face segmentation and face detection model to identify the classroom images in the data storage module, connect students' seat positions with students' individual academic performance, classify students into excellent, good, and average students according to their academic performance, draw a scatter plot as shown in Figure 13, with two

coordinates representing positions, and finally update the scatter plot to student data and teacher feedback information. The teacher can take care of more students in a comprehensive and targeted way based on this data.

This offline classroom quality two-way evaluation system is a convenient and fast way to obtain information, and it can reduce a lot of time costs and effectively improve teachers' teaching efficiency and students' learning efficiency.

## 6. Conclusions

Based on educational teaching reform, this paper uses quantitative statistical methods to evaluate the data generated in the core aspects of teaching, adopts modern intelligent information processing theory as the core data processing method and technology, uses educational teaching theory and experts' cognitive achievements as the domain theory, effectively quantifies the importance of key factors through machine learning strategies, effectively synthesizes complex factors, and generates quantitative evaluation results. The methods for selecting factors affecting teaching quality, quantifying the relative importance of each factor, and generating evaluation results are based on intelligent information processing theories and methods with machine learning as the core and have a relatively sound theoretical foundation and basis.

The work in this paper simultaneously considers the cognitive results of educational teaching theory and expert experience with intelligent information processing methods and achieves the task of intelligently evaluating teachers' teaching quality based on domain theory and guided by typical cases. China's research and practice in the field of educational measurement and evaluation are very weak, and our future research work still needs to address many theoretical and practical issues, mainly including (1) the completeness of the measurability factors that determine teaching quality, which needs to seek reasonable and effective answers within the framework of educational theory; (2) the use of new theories and methods in the field of intelligent information processing, which has a significant impact on China's higher education development, and to make use of new theories and methods in the field of intelligent information processing to effectively mine and process the big data generated within the macroscopic scope of the reform of Chinese higher education, so that the intelligent quantitative evaluation of teaching quality tends to be perfected.

## Data Availability

The raw data supporting the conclusions of this article will be made available by the author, without undue reservation.

## Conflicts of Interest

The author declares no conflicts of interest regarding this work.

## Acknowledgments

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