Research on Teachers' Behavior in the Class Recognition on Based on Text Classification Technology

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Abstract—**Teachers' behavior in the classroom is the key factor that affects the quality of teaching and students' learning. In order to improve the accuracy of teachers' behavior in the classroom recognition, this study uses multiple in-depth learning models to identify teachers' behavior in the classroom. Before the experiment, the teacher's behaviors are marked and classified. The teacher's speech is divided into sentences as the experimental data. The experiments use the model of deep learning technology for classification. Finally, by comparing the indicators in each model, this paper verifies that the use of deep learning technology can effectively and automatically identify teachers' teaching behavior in the class and realize the automatic classification of classroom teachers' behavior. The research shows that the use of deep learning text classification technology to identify teacher behavior can significantly reduce the cost of classroom teacher behavior analysis, improve the efficiency and timeliness of analysis.**

Keywords- Deep learning technology; Classroom teacher behavior; Text classification technology; Classroom teacher behavior coding; Automatic classification;

I. INTRODUCTION

With the constantly reform of educational teaching mode, the teachers' teaching behavior in the classroom has become a research hotspot in the field of Education [1]. In exploring the influence of the teachers' teaching behavior in the classroom on students' learning, it is found that the behavior of teachers can cause, maintain and promote students' learning, which is the key to improve the quality of the teachers' teaching behavior in the classroom, the focus of school teaching reform and the most important factor to promote students' learning[2]. Therefore, if we can identify teachers' behavior quickly and effectively, it will provide great help for the development of education and teaching. The traditional way to explore the behavior of the teachers' teaching behavior in the classroom is to use the way of manual coding, through manual observation, manually record and analyze data. This method has the characteristics of small sample size and strong subjectivity, which is not conducive to the discovery of general classroom teachers' behavior rules [1].

With the continuous development of information technology and multimedia technology, new methods and tools for teachers' teaching behavior in the classroom recognition and analysis have been produced and applied [1]. In recent years, here are more and more research topics on the processing and analysis of teaching behavior through classroom teaching video. Guan Qin et al. Based on the online open class video, the teacher and student behaviors in the video are labeled and quantified, and the analysis results are combined with the user evaluation in the video open class platform to get the relationship between classroom teaching behavior and course results, so as to make reasonable suggestions for the production of online open class[3]. However, the video annotation algorithm is generally used for classroom video annotation, which is used for classroom video annotation The teaching video scene has higher requirements, because of the different shooting technology and shooting angle, it will also have an impact on the classroom teaching analysis. In addition to the text images in the video, teaching audio is also one of the important ways to analyze classroom teaching behavior. Zijian Fan and others use pickups to collect the audio of teachers and students in the teaching process, realizing the recognition of teachers' instructions and the analysis of classroom language, providing great help for teachers' teaching level evaluation[4]. However, the use of audio analysis for classroom teaching requires a high level of classroom environment. When students discuss or answer questions collectively, the existing technology can not identify each person's discourse information completely at the same time, resulting in semantic ambiguity and information loss. Therefore, in view of the above problems, this experiment will analyze the classroom teachers' behavior from the semantic level. In the experiment, the teacher's language in the classroom video is transformed into text, the sentence is taken as the unit, the pause is taken as the mark to separate the sentence and recorded in the system. Combined with the teacher's teaching behavior coding system, the categories of the sentence is marked. Finally, the in-depth learning technology and text classification technology are used to realize the automatic coding of the classroom teacher's behavior. The experimental results show that the in-depth learning text classification technology, classroom teacher behavior recognition system can achieve the automation of coding process, more realistic and objective analysis of teacher language behavior, thus providing help for the establishment of a scientific teaching evaluation system.

II. CONSTRUCTION OF TEACHER BEHAVIOR CODING SYSTEM

A. The construction of behavior coding system for classroom teachers

Using text classification technology to analyze classroom teachers' behavior, we should express the analysis indicators in a quantifiable way. In the classification of classroom discourse

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behavior, the most mature is Flanders Interactive Analysis System (FIAS). Flanders divides the traditional classroom discourse behavior into 10 categories. With the continuous development of information-based classroom and the introduction of multimedia devices in the classroom, the teacher's speech behavior in the classroom has also changed. The traditional teacher's speech behavior indicators are not applicable. Therefore, Gu Xiaoqing, a domestic scholar, and others have proposed the information technology-based interaction analysis system (ITIAS)[6] , the following is the code for teachers' behavior in the interactive analysis coding system based on information technology, as shown in Table I.

TABLE II CODING OF TEACHER BEHAVIOR IN INTERACTIVE ANALYSIS CODING SYSTEM BASED ON INFORMATION TECHNOLOGY

Teachers' language	***Indirect language***	1	Teachers accept emotions	
		2	Teacher encouragement and praise	
		3	Teachers take advice	
		4	teachers' questioning	Ask opened questions
				Ask closed questions
	Direct language	5	Teacher's instruction	
		6	Teacher's orders	
		7	To criticize or assert the authority of a teacher	

The experimental materials of this study are 627 videos of the senior class mathematics class of primary school students in a national classroom teacher teaching competition, with an average duration of 45 minutes. The competition is divided into four categories: first prize, second prize, third prize and no prize. 10 videos are selected from each category. We choose 40 videos as the basic materials of the experiment. Through the analysis of ITIAS and classroom teacher behavior review, it is found that[7,8,9,10], researchers analyze teacher behavior from different perspectives and methods, but all of them contain some common characteristics, which can be divided into three categories: teaching, instruction and questioning. Based on the above research, a teacher behavior coding system suitable for this study is developed. See Table II for details.

TABLE III TEACHER BEHAVIOR CODING SYSTEM

Classify	Coding	Formulation	Content
Teachers' language	1	***teach***	Provide facts or insights on content steps, express the teacher's own ideas, or cite an authority (not the student)
	2	***instructions***	To instruct or command a student to do something, which has the function of expecting obedience
	3	***quiz***	Based on the teacher's opinion or ideas, ask the students questions and require their answers

It can be seen from the above table that the setting of classroom teachers' behavior standards is mainly composed of indicators of interactive analysis system based on information technology. The first level indicators are classified into teacher language, and the second level indicators are divided into three aspects: teaching, instruction and questioning. In order to verify whether the above coding system is reasonable or not, the experiment of determining the coding system of classroom teachers' behavior is carried out.

B. The determination of the behavior coding system of classroom teachers

1) Data preprocessing

In order to study the validity of the research, 40 teaching competitions were analyzed by hand, which were made into training set, verification set and test set. Data preprocessing is divided into three parts: original data, video processing and manual annotation. In the video processing part, the main operation is to convert video into text. First, convert video into audio. There are many ready-made tools available in the current market, such as format factory, QQ voice. This study uses format factory for conversion. The speech recognition module of IFLYTEK platform has the advantages of fast writing speed and high accuracy. Therefore, this research adopts the speech recognition tool of IFLYTEK platform to carry out speech recognition. The transformed text is divided into 16544 sentences based on punctuation by using Chinese clause technology. The manual annotation part, based on the classroom teacher behavior coding system developed in this experiment, manually divides the text into three types: teaching, instruction, and questioning, and sorts the processed data.

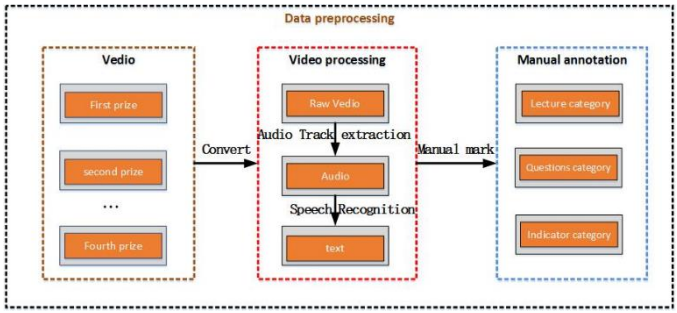

Fig. 1 DATA PREPROCESSING FLOW

2) Class teacher behavior determination

After sorting the data, in order to verify whether the teacher behavior coding system developed this time is suitable for this study, the above data is classified and statistic.

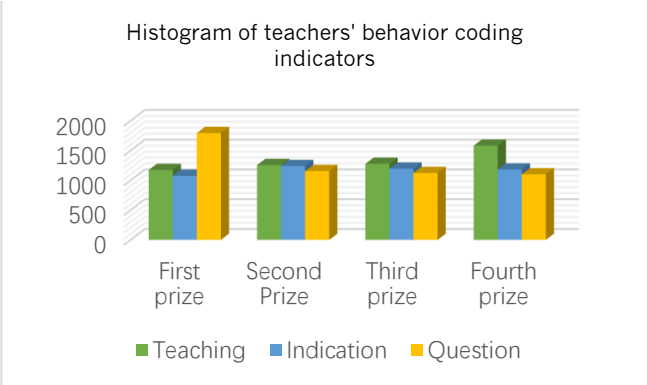

Fig. 2 TEACHING BEHAVIOR CODE DISTRIBUTION

The experimental results found that for the *teaching*, the proportion of the fourth prize is the largest, and it is also the largest of the four prizes, close to 1,600, and the other three prizes are about 1,200. For *questions*, the largest proportion of first-class awards is also the longest in the four categories, with a total number of about 1800, while in the other three awards, the number of questions is about 1100. As for the *indication*, indicator, it is lower in the first prize, and there is not much difference in the other three prizes, which are around 1200. It can be seen that the classroom teacher behavior standards

formulated in this experiment can clearly divide the teachers' teaching behaviors in the four awards, find out the characteristics of classroom teacher behaviors in different awards, facilitate quantitative recording, and explore the relationship between teacher behaviors. And these three types of behaviors not only reflect the basic characteristics of classroom teacher behaviors, but also the key indicators of teachers 'grasp of the entire classroom, and to some extent reflect the status of teachers' teaching skills. Based on the above, it was finally determined that the classroom teacher behavior coding system developed this time is suitable for this study.

III. RELATED TECHNOLOGY INTRODUCTION

The text classification technology of natural language processing part is divided into traditional classification and neural network classification. Traditional models include decision tree, k-nearest neighbor algorithm and naive Bayes algorithm. However, in the text model representation and feature selection stage, the sentence classification method of the traditional model has some shortcomings, such as complex feature extraction, easy to ignore the context structure information of the extracted features and long training time of the model, so this paper chooses the neural network model for research. The deep learning model of neural network model has the advantages of representation learning, sequence modeling and good flexibility. Therefore, this experiment uses deep learning model for text classification [11].

A. Convolutional neural network (CNN)

Convolution neural network is a kind of feedforward neural network, which consists of several convolution layers, pooling layers and full connection layers. The structure of convolution makes the convolution neural network simplify the process of text preprocessing, extract high identification text features, and reduce the workload of feature engineering. The function of the convolution layer is to extract features from multiple convolution check text vectors, then reduce dimensions through the pooling layer, retain important feature information, output a fixed size matrix to the full connection layer, release the multi-dimensional structure to expand into vectors, and output classification results through the softmax excitation function. Although convolutional neural network can learn local response from time or space data, it lacks the ability to learn sequence correlation [12].

B. Long short memory neural network (LSTM)

Long short term memory (LSTM) is a special kind of recurrent neural networks(RNN), on the basis of ordinary RNN, memory units are added to each neural unit of the hidden layer to make the memory information on the time series controllable. Each time the information is transferred between each unit of the hidden layer, through several controllable gates (forgetting gate, input gate, candidate gate, output gate), the memory and forgetting degree of the previous information and the current information can be controlled, so that the improved model has It has long-term memory function. There are three inputs to the LSTM model: the input value xt-1 of the current time network, the output value ht-1 of the previous time LSTM, and the cell state Ct-1 of the previous time. There are two outputs of the LSTM model: the output value $\boldsymbol{h_t}$.of the LSTM at the current time and the unit state C_t. at the current time. The LSTM model uses the "gate" switch to control the long-term state C. ,in which the forgetting layer: determines what information is discarded from the cell state, which is determined by the current time input and the previous time output; the cell state: determines and updates the information to the current time cell state; the output gate layer: determines the current LSTM output based on the current cell state. Although the long-term and short-term memory network (LSTM) model has improved the RNN model in structure, making up for the disadvantage that it can't learn and rely on information for a long time, it still can't extract features in a parallel way[13]. The calculation formulas (1) to (6) of the elements in the LSTM model are as follows:

$$\boldsymbol{f_t = \sigma(W_f[X_t,\ h_{t-1}] + b_f)} \tag{1}$$

$$\boldsymbol{i_t = \sigma(W_i[X_t,\ h_{t-1}] + b_i)} \tag{2}$$

$$\boldsymbol{\widetilde{C_t} = tanh(W_c[X_t,\ h_{t-1}] + b_c)} \tag{3}$$

$$\boldsymbol{C_t = f_t * C_{t-1} + i_t * \widetilde{C_t}} \tag{4}$$

$$\boldsymbol{o_t = \sigma(W_o[X_t,\ h_{t-1}] + b_o)} \tag{5}$$

$$\boldsymbol{h_t = o_t * tanh(C_t)} \tag{6}$$

In the above formula,$\boldsymbol{W}$、$\boldsymbol{b}$ are parameters for automatic learning; $\boldsymbol{X_t}$ represents the input of the current cell; $\boldsymbol{h_{t-1}}$. represents the output of the hidden layer at the previous moment; $\boldsymbol{\sigma}$ is the sigmoid function; $\boldsymbol{f_t}$ represents the forget gate; $\boldsymbol{i_t}$ represents the input Gate; Medium$\boldsymbol{\widetilde{C_t}}$ Alternative content for updating; $\boldsymbol{C_t}$ is the update content; $\boldsymbol{o_t}$ is the output gate; $\boldsymbol{h_t}$is the output at this moment.

C. Convolutional neural networks and long-term and short-term memory neural networks model(C-LSTM)

Convolutional neural networks and long-term and short-term memory neural networks each have advantages and disadvantages in text processing tasks. Convolutional neural networks use more convolution kernels to convolve word vectors of text to more effectively mine the underlying semantic information of text. The long and short-term memory neural network can better predict the semantics of text sequences. Combining these two types of neural networks, this study uses a neural network model based on CNN and LSTM-the C-LSTM model. The model structure uses a convolutional neural network (CNN) for feature extraction in the input data. LSTM model to classify predictions [14].

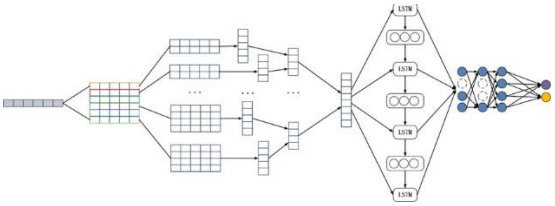

Fig. 3 The structure of the C-LSTM model

In the feature extraction stage, as the pre-processed experimental data has short and refined features, the CNN model input layer is represented by sentence vectors, and local feature extraction is performed through a convolution module composed of 128 convolution kernels. The size of the convolution kernel Always: 3, 4, 5, with a loss rate of 0.5. The extracted feature matrix is input to the pooling layer. The maximum pooling operation is used to further feature extraction and dimensionality reduction of short text sentences to obtain generalized binary and ternary feature vectors. After fusion, the two types of feature vectors are stitched. Together, as the input matrix of the LSTM model.

In the model classification stage, the feature matrix is input into the LSTM neural network structure. The number of hidden units in the LSTM model of this experiment is 256. After a series of "gate" control switches, the classification results are finally output.

D. Experiment and result analysis

1) Experimental environment

The hardware parameters of this research experiment platform are Intel (R) Core (TM) i7-4790 CPU + 8GB memory, operating system Windows Server2008R2, programming language adopts Python3.6, and deep learning platform is Tensorflow1.13. Based on this, system development and Experimentation.

2) experimental steps

The experimental part is divided into two parts: data preprocessing and training data

a) Select ,Select the video file and translate it into a text file.

b) Data pre-processing, manual labeling according to the coding system, divided into training set, validation set and test set.

c) Input data, Input the data in the training set into three types of models, and train them in the CNN model, LSTM model, and C-LSTM model.

d) Debugging, Input the validation data to continuously debug the parameters in the model, improve the training accuracy rate, and make the training model stable.

e) Testing, Enter the data in the test set into the trained model for testing, and take the average value for multiple tests.

f) Compare, Compare the results of the three models for analysis.

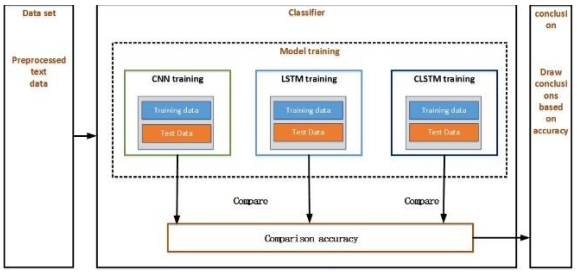

Fig. 4 THE SPECIFIC STEPS

E. experimental results and analysis

On the Tensorflow platform, use python to enter a specific command line, and provide the training text as a training data set to the model that has been programmed. After the training is completed, the test is performed, the relevant data is recorded, and the index data corresponding to the different classification methods are sorted

TABLE IV EXPERIMENT RESULTS

Test model	*Time-consuming training(min)*	*Time-consuming test (s)*	*Accuracy (%)*
Manual classification	***40320***	———	———
CNN model	***16***	***2.30***	***85.15***
LSTM model	***47***	***2.16***	***80.1***
CNN-LSTM model	***70***	***2.35***	***86.87***

In order to reduce the deviation of training accuracy caused by data set selection, this study conducted 10 random experiments. The ratio of training set to test set in the experiment is 14:1. As can be seen from the table above, in the experiment of classifying classroom teacher behavior, the classification accuracy rate is the highest C-LSTM model. Therefore, the comprehensive indicators can be found that the overall better solution should be the C-LSTM model. The data set of this experiment is small, and it is foreseeable that the effect of the C-LSTM classification model will increase with the further expansion of the training text Get further improvement, and manual classification does not have this ability to constantly learn and improve.

IV. SUMMARY

This experiment uses deep learning text classification technology to analyze and study classroom teaching behavior, and proposes a solution to classify classroom teaching behavior automatically. The length of a standard elementary school mathematics class is 40 minutes. According to the experiment, a teacher speaks between 3000 and 5000 words in a fourth grade mathematics class. According to the teacher 's natural discourse, the average teacher can speak 500 Sentence. The duration of a semester mathematics class can reach tens or even hundreds of hours, all of which are manual classification, which will waste a lot of time, and manual classification will also be affected by the efficiency and accuracy of long working hours, while machine classification There is no need to worry about this at all. Therefore, from the perspectives of time and economic cost, the

classroom learning behavior classification scheme based on deep learning has very obvious application advantages. In addition, the current experimental data volume is small. With the expansion of the text data volume, the advantages of deep learning-based classroom teaching behavior classification schemes are more obvious, and it has a wide application prospect in the future education field.

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