



## Developing a Systematic Model of College Students' General Education Based on Deep Learning with Collaborative CAD

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**Abstract.** The primary objective of general education is to equip students with the necessary knowledge, skills, emotional disposition, and values essential for the successful implementation of general education curriculum. This approach is grounded in the cultivation of moral values, theoretical understanding, and societal expectations. The criterion for evaluating intellectual development is the internalization of social and moral qualities and the externalization of behavior. The core focus of general education is the acquisition of general knowledge and skills. DL (Deep learning) refers to the process of students acquiring knowledge through self-directed learning, critical thinking, and the integration of existing and new information. This approach enables students to develop a new knowledge system and master the fundamental knowledge and thinking techniques of the subject under the guidance of professors. This study utilizes a DL systematic model to teach college students general education. It employs a network teaching environment to enable students to promptly assess their mastery of theoretical knowledge through the self-test platform provided by the system. This allows students to engage in the course process actively. In order to selectively enhance or forget prior knowledge, the attention mechanism and GRU (Gated Recurrent Unit) unit are employed. Additionally, many computational layers are overlaid to update the prior knowledge. The findings indicate that the inclusion of the real entropy function score in the model indicates temporal regularity, resulting in an increase in the accuracy of the test set to 75.036%. One of the models that has demonstrated a classification accuracy of 83.79% in evaluating specific elements in comments is the Deep Memory Network (DMN) model. The findings indicate that the DMN model, as proposed, demonstrates a significant enhancement in the accuracy of emotion classification at the aspect level.

**Keywords:** Deep learning; Collaborative CAD; General education; College students; Systematic model

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## 1 INTRODUCTION

The practice has proved that the implementation of general education (general theories teaching in all courses) teaching reform has played an important role in further enhancing teachers' moral awareness, leading students to establish socialist core values, and promoting the development of university professional education and general education (general education) in the same direction and in parallel. The rich content and lively and interesting forms in the classroom are also easy to infect and make students accept, which better mobilizes the enthusiasm and initiative of students' participation and improves the effectiveness of general education teaching in universities. However, this kind of approach is more likely to lead to a lack of in-depth understanding of general education and students' strong utilitarian mentality in learning, which leads to students studying for exams in general education. At present, most teachers have grown up under the traditional teaching philosophy, and they have taken teachers as the main body of fixed thinking.

Analyzing and implementing the fundamental principles of systematics in the field of general education represents a novel and innovative approach to systematics in the humanities. It also serves as a significant catalyst for fostering innovation in the humanities. When developing a systematic teaching method, it is important to consider factors such as the current era, relevance, efficacy, and proactive approach [1]. When considering educational objectives, it is crucial to comprehensively understand information, skills, emotional attitudes, and values in order to emphasize the integrity of the International Political Economy (general education). In light of these recent alterations and novel circumstances, unresolved issues remain in the realm of higher theoretical education and instruction. The foundation of the development of the discipline is lacking in strength, with repetitive course content, inconsistent quality of teaching materials, limited teaching methods, and a lack of relevance and effectiveness in teaching. The integration of general education with university education is lacking, particularly in relation to the current situation of college students. Additionally, the current general education in higher vocational colleges primarily focuses on theoretical and conceptual knowledge, making it challenging to delve into in-depth detail. Furthermore, the practical lessons are not given due importance [2]. An exclusive focus on the development of professional skills education results in a deficiency in students' cultivation of humanistic qualities and professional ethics. These factors have posed significant obstacles to the field of general education in universities.

The purpose and goal of university general education is to teach students to look at the experiences and problems in China's revolution and construction from the basic standpoint, viewpoint, and method of Marxist theory and to respect the objective laws of social development. Curriculum evaluation can effectively guide teachers' teaching activities and is an important link to promote the implementation of general education teaching practice. In the construction of a systematic mode of general education teaching, the systematic method points out the overall research method, and at the same time, curriculum development and distribution are carried out in all links within the system, which is the systematic cycle of curriculum modules. The systematic model of college students' general education teaching supported by deep learning technology constructed in this study not only contributes to the effective development of college students' general education teaching but also has strong guiding significance for the design and implementation of general education teaching for similar courses.

Research contribution:

(1) There is an inherent logical interweaving and correlation between learning and general education. From the design mode of general education and the construction of the general learning mode to the preliminary exploration of the general education implementation system and the construction of the general education evaluation mode, it provides a constructive layout scheme for the planning and control of teaching activities.

(2)According to the characteristics of students' teaching evaluation scene and the deficiency of related emotion analysis research at present, the improved DL model is applied to emotion analysis of students' teaching evaluation. Through the attention mechanism, useful information in memory is extracted to update prior knowledge, and the extracted emotional information is used for emotional classification.

This paper consists of five chapters, and the specific structure is as follows:

The initial section provides an overview of the research's background work. The primary focus of the second section is to provide an overview of the current state of this study. The systematic model of general education teaching is presented in the third section. The performance of the model examined in this study is verified in the fourth section. The conclusion is presented in the fifth section.

## 2 RELATED WORK

### 2.1 General Education Construction Status Quo

General education integrates the education requirements into the discourse system of professional teachers from the perspectives of moral education, Chinese excellent traditional culture education, and values education. Implement the "Tutor Group for Student Growth" so that professional course teachers, general education teachers (counselors), and social resources can cooperate in educating people [9]. Li et al. made specific arrangements for general education's construction objectives, requirements and contents, teaching system design, promotion strategy, quality evaluation system, incentive mechanism, organization, and implementation [6]. Hai put forward the working mode of general education based on the concept of collaborative education and advocated the collaborative education mechanism of general education explicit education and other courses in invisible education [4]. Sun et al. advocated that general education resources in the subject culture should be tapped by strengthening the top-level design, implementing the primary responsibility, establishing the problem orientation, implementing the project traction, and establishing the national consciousness [10].

Huang et al. analyzed the political construction of socialism with Chinese characteristics from three dimensions. They believed that the political construction of the party is the fundamental construction of the party, which is related to the overall situation [5]. Zhu et al. believe that the socialist core value system, born in response to the development of the times, is a unique theoretical system in China with profound connotations and rich content [19]. Zhang et al. think that general education is a method for universities to embody values in implementing the fundamental task of moral education and a method for realizing the essential task of moral education [17]. Wang believes that it is necessary to strengthen teachers' moral education awareness and optimize the value of the college governance structure [11]. General education's cross-border collaborative education mechanism enhances teachers' teaching enthusiasm and significantly improves teachers' teaching levels and the student's learning support system.

### 2.2 DL Technology Research

With improved computer computing power and a substantial increase in data, DL(Deep learning) has become a vital learning theory for solving big data problems. Its application in image processing and other fields has achieved good results. Many neural network models, including CNN and recurrent neural networks, are currently used in natural language processing tasks. In feature learning, sequence information can be learned and widely used in machine translation, text classification, and other tasks.

Regarding the DL model, Xu et al. put forward the FastText model, which first averages all the word vectors in a sentence and then connects with the softmax layer, which is very simple and direct [13]. Wu et al. introduced the attention mechanism in the text, arguing that different parts of the text have different weights for text classification and machine translation tasks, and the attention mechanism is the training process to get this weight matrix [12]. Zhang et al. used CNN (Convective Neural Network) to classify medical texts at the sentence level [18]. The input of this kind of text classification is much less than that of character-level text classification, which keeps more information in the text context and achieves a better classification effect while shortening training time.

Sentence sentiment analysis takes a single sentence in a document as the primary information unit and classifies each sentence into sentiment. Xu et al. proposed a sentence-level DL model to overcome the disadvantage of poor merging effect, which used two gated recurrent neural networks [15]. Yu et al. proposed learning the semantic information of contextual words from the target words' left and right directions, increasing attention to improving the model effect and adding multiple gates in the model to control their attention value [16]. Zvarevashe et al. used CNN to extract facial features and LSTM (Long Short-Term Memory) to fuse it with background information for estimation [20]. Kalaiselvi et al. introduced a text-mining method to analyze students' comments on teachers' performance. They used SVM(Support Vector Machine) and RF(Random forest) algorithms to complete the sentiment analysis [8].

### 3 METHODOLOGY

#### 3.1 Overall Design of Systematic Model of General Education

General education aims at the knowledge, ability, emotional attitude, and values the curriculum should achieve. It relies on moral cultivation, theoretical knowledge, and social requirements, takes internalization of social, moral quality, and externalization of behavior as the criterion, and takes general knowledge and ability as the core. Teachers' intentional or unintentional edification of students through words and deeds is an external necessary environment and a representation of the moral subconscious. General education considers this as its internal ideal, belief, and knowledge structure, and its composition meets the needs of the new era of social development. This structure can clearly characterize general education to support and guarantee the maximization of teaching value. Promote general education's purpose and task control and ensure its regularity, planning, and the combination of details and the whole.

From the macro level, general education integrates general education elements into all kinds of courses so that all courses cooperate to play an educational role. It is a process in which teachers guide students to learn independently and cooperatively by creating teaching situations and completing the meaning construction. Emphasizing students' dominant position in the cognitive process has the outstanding advantage of being conducive to students' independent inquiry and discovery and fostering creative talents. We should flexibly choose teaching design according to different teaching objectives, teaching contents, and teaching objects.

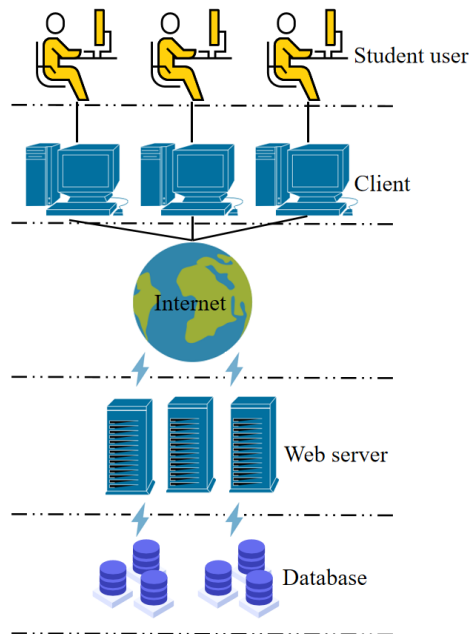
General education emphasizes the teaching activities of solving problems in real situations, exploring, and practicing. It is necessary to make general education teaching vivid and intuitive so as to stimulate students' subjective initiative and improve their virtue practice ability through interactive and inquiry activities.

Take DL as its fundamental pursuit to cultivate students' core literacy. Paying attention to digging into the meaning behind knowledge, cultivating students' mathematical thinking, and grasping the essence of knowledge are important ways to implement core literacy. Under the

guidance of teachers, DL is the learning of students through self-directed learning, critical thinking, and the integration of old and new knowledge so as to build a new knowledge system and master the core knowledge and thinking methods of the subject. It emphasizes students' subjectivity and is an integral part of mathematics literacy. It can not only help students form a good cognitive structure but also help students better transform knowledge into ability, which is the key to promoting the development of thinking.

The network is a very good platform that we can use. Students have great initiative and selectivity in controlling the learning time, progress, and content selection. Computer-assisted instruction endows education with new contents and concepts, promotes the reform of education, and adapts it to the development of society. It is conducive to changing passive education into active education and exam-oriented education into quality education. Fundamentally change the current situation that theoretical teaching is seriously out of touch with practical teaching, and there is a lack of standardized system guarantee and working mechanism.

According to the systematic model of college students' general education teaching based on DL, students can assess their mastery of theoretical information and actively engage in the course process using the self-test platform supplied by the system, thanks to the network teaching environment. As depicted in Figure 1 presented below.



**Figure 1:** Overall system framework diagram.

The regularity of individual learning behavior is assessed by examining the definition of users' online learning behavior and determining the associated actual entropy. The relationship between regularity and users' successes is then investigated. The attributes of the user's learning duration are transformed into a two-dimensional coordinate system for the purpose of visualization, resulting in the creation of a scatter diagram representing the user's learning time. The subunits encompassed in this study are attendance analysis and feedback, attendance rate analysis and feedback, classroom conduct analysis and feedback, classroom expression analysis and feedback, and classroom seat analysis and feedback.

### 3.2 Emotional Analysis of Students' Teaching Evaluation Based on DL

Teachers can collect teaching information for feedback, including the evaluation and suggestions of the school supervision team. At the same time, it is necessary to rationally design the formative assessment in stages, including assessment time, content, and form. This includes carefully designing online and offline discussion topics, teaching practice, subject competitions, and other assessment contents and examining the changes in students' emotions and values to test the educational effect of General education.

Give full play to the role of information networks in general education under the background of the new media era, break the limitations of learning form and learning area, and you can learn anytime and anywhere. Full-house irrigation in general education classes is still relatively common, and there is a lack of practical teaching to consolidate theoretical knowledge and deepen theoretical understanding. Social practice is the natural extension of college general education practice teaching, the closest contact between college students and society, and the critical carrier of college students' general education. The practice bases established by colleges and universities are primarily off-campus practice bases related to majors, lacking a remarkable "education-oriented" off-campus practice base for ideological and political courses.

With its distinctive features of short content, clear theme, and independent structure, general education is suitable for learners' personalized learning, mobile learning, flip classrooms, and other mixed learning methods. In the whole stage, the design and completion of practical projects can help the teaching and construction of a specific part of general education knowledge, but it lacks the systematic construction of the whole course. Therefore, we make up for this defect through a knowledge map, effectively organize knowledge points, and show the relevance and structure among knowledge points. Moreover, it is necessary to comprehensively consider students' personality characteristics, actual preferences, and behavior habits so that users can feel the convenience of the online teaching recommendation system and learn in a happy mood. When learners register for online teaching, the recommendation system can analyze the information filled in by students and recommend the most suitable courses that can meet users' needs according to the actual situation of users. Learners can also choose courses or adjust the developed course plans.

Teaching evaluation is a crucial way to collect students' feedback information to help them understand and improve their teaching. Emotional tendencies express students' intuitive feelings about teaching and are important indicators for measuring teachers' performance. Therefore, it is the key to fully realizing the teaching function of general education by using DL-based affective analysis technology to mine students' affective tendencies from a large amount of general education data.

Statistical models are used to calculate the probability of a sentence, that is, a word sequence [7],[1]. Assuming that the order of words in the context is unchanged, the closer the correlation degree of words with close distance is, the farther the correlation degree of words with far distance is. If the distance is far enough, there is no degree of correlation between words. Through the Bayesian formula, the probability of a sentence is expressed as:

$$p(w_1^T) = p(w_1) \cdot p(w_2|w_1) \cdot p(w_3|w_1^2) \cdots p(w_T|w_1^{T-1}) \quad (1)$$

Where  $w_1^T$  is a sentence consisting of  $w_1$  to  $w_T$  once.

The Kalman filtering algorithm uses the face target's current position information to predict the next frame's position. The state and measurement equation of the Kalman filtering algorithm is as follows:

$$X_k = AX(k-1) + BU(k) + W(k) \quad (2)$$

$$Z_k = HX(k) + V(k) \tag{3}$$

Where  $A, B$  is the state matrix and control matrix,  $H$  is the measurement matrix,  $X_k, X_{k+1}$  is the state variables of the previous and the next moment, and  $V, M$  is the state noise and observation noise matrix.

The SVM algorithm is a typical discriminant classification algorithm. The algorithm's core is to calculate the maximum classification interval, that is, to find an optimal hyperplane to divide the original data so that the classification plane is  $f(x) = w^T x + b$ , where  $w$  is the weight vector, and  $b$  is the offset. Then, the distance between the support vector  $x_0$  and  $f(x)$  is:

$$\gamma_0 = y_0 \left( \frac{w}{\|w\|} \cdot x_0 + \frac{b}{\|w\|} \right) \tag{4}$$

When neurons use different activation functions, they show different mathematical models. When neurons in a multilayer perceptron use identical activation functions, it is still equivalent to a single-layer perceptron. The sigmoid activation function is a commonly used activation function of early neural networks, and its mathematical expression is shown in formula (5):

$$f(x) = \frac{1}{1+e^{-x}} \tag{5}$$

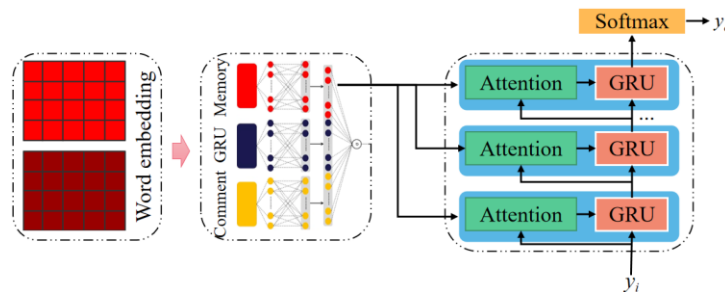
It can compress the input values distributed from negative to positive infinity to 0 to 1, also called a logistic regression function.

The core of layered softmax is to transform the tedious normalized probability into the product of several conditional probabilities:

$$p(v|context) = \prod_{i=1}^m p(b_i(v)|b_1(v), \dots, b_{i-1}(v), context) \tag{6}$$

Hierarchical softmax adopts a tree structure to reduce the calculation amount of the final output layer in the model. Although hierarchical softmax adopts a tree structure to reduce the calculation amount of the loss function effectively, its calculation amount is still huge because uncommon words are far from the roots of trees [3].

In this paper, a DMN(Deep memory network) with prior knowledge is proposed, which is used to combine the prior knowledge of comments to realize the aspect-level emotional analysis of students' teaching evaluation. The model mainly includes four modules, in which the word embedding module represents the comment context as a vector form recognizable by the computer. An attention mechanism is used to extract useful information from memory to update prior knowledge, as shown in Figure 2.



**Figure 2:** DMN model structure with prior knowledge.

The proposed model comprises four distinct components: the input module, memory module, circular attention module, and output module. To represent context aspects more precisely, the

memory module employs a bidirectional GRU (Gated Recurrent Unit) network to model the context's semantic information.

The emotional characteristics present in comments encompass not just the individual and localized attributes of words but also sentences that exhibit a significant reliance on context. To enhance the accuracy of classifying students' emotions, it generates a multitude of comments and extracts more precise emotional characteristics through the utilization of context dependence. The GRU model can be represented in a simplified manner as:

$$h_t = GRU(x_t, h_{t-1}) \quad (7)$$

In the teaching process, by analyzing students' facial expression features and accurately exploring students' emotional state, students' current learning state can be effectively detected. Teachers can't always pay attention to the emotional state of every student without affecting the teaching progress.

By analyzing the degree of students' eyebrows stretching, the degree of mouth closing, and the radian of corners of the mouth, we can determine the degree of students' doubts. When students' eyebrows are tight, their mouths are open, and the corners of the mouth are curled downwards, they are confused about their current learning state and may have difficulty accepting their current learning knowledge.

The formula for calculating the degree of doubt  $w(t)$  is:

$$w(t) = \frac{\sum_{i=1}^N q(\delta^t)}{N} \quad (8)$$

$t$  is the moment, and  $N$  belongs to the total number of students. Write  $q(\delta^t)$  as 1; When the system detects that the angle of the student's head is not in the blackboard, it records the student's learning state as a non-concern state and the  $q(\delta^t)$  is 0.

The face is judged as a binary classification problem, and the cross entropy loss function is used:

$$L_i = -\det \left( y_i \begin{matrix} \det \log(p_i) \\ (1-y_i)^{\det 0(1-\log(p_i))} \end{matrix} \right) \quad (9)$$

To output the features extracted by the model as the emotion classification results of the target words, the model uses a fully connected layer as the output network for emotion classification. The whole connection layer receives the output  $O$  of the attention layer of the target word as input. The output vector  $\hat{y}$  of the model is obtained by learning the output network and finally normalizing the vector using the softmax function. The calculation process of the output layer is shown in Formula (10):

$$\hat{y} = \text{softmax}(OW_o + b_o) \quad (10)$$

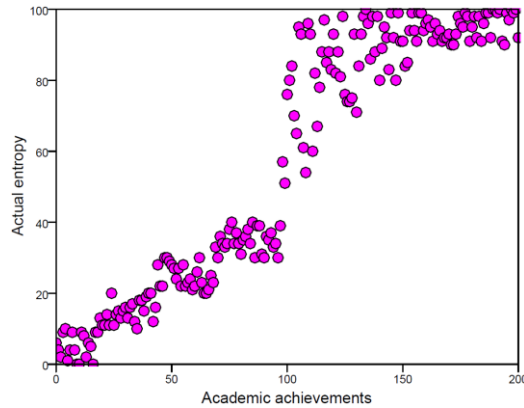
Where  $W_o \in R^{d_{model} \times c}$ ,  $b_o \in R^c$  is a trainable parameter of the output layer and represents the number of types of emotion classification.

#### 4 EXPERIMENT AND RESULTS

Its comments have good grammatical and semantic quality and sufficient data, so it is very suitable as a corpus for emotional analysis of students' teaching evaluation. After simple pretreatment, the comments' aspect and emotion tags must be manually marked. Finally, a data set containing 1200 general education comments is obtained, and each comment has a corresponding score and manually annotated aspect tag and emotion tag.



Calculate the user's entropy function, give the corresponding ranking, and then sort according to the user's actual grades, and draw the scatter diagram of the correlation between actual entropy and grade ranking Spearman, as shown in Figure 3.



**Figure 3:** Correlation scatter plot.

In this paper, the score of the actual entropy function is added to the model as the dimension of time regularity. Finally, the accuracy of the test set is increased to 75.036% so that the model's prediction accuracy can be enhanced by fully mining the online users' learning logs.

For the emotion analysis process, feature selection may be more critical than classifier selection, and good features have a specific representative effect on the whole category. Table 1 compares the number of candidate feature words obtained using different stoplists.

<i>Stop vocabulary</i>	<i>Number of initial feature words</i>	<i>The number after removing stop words</i>
<i>Tradition</i>	<i>5360</i>	<i>2601</i>
<i>Emotion</i>	<i>5360</i>	<i>4128</i>

**Table 1:** Comparison of the number of characteristic words after different stoplists.

It can be seen that, under the same corpus, the number of feature words after stopping the word list processing is much less than that of untreated feature words. The number of features processed by an emotion stoplist is nearly 2000 more than that processed by a traditional stoplist, which shows that the number of features obtained by different stoplists is quite different. Therefore, using a particular emotion analysis stoplist can reduce the dimension of feature space to a certain extent and keep much subjective emotional information in the text.

In this paper, the student's learning situation in 40 minutes is selected as a comparison, and the students' learning situation is recorded every two minutes. Figure 4 shows the comparison results of students' attention, and Figure 5 shows the results of students' doubts.

The experimental results show that the results of this method are the same as those of manual statistics. The comprehensive calculation accuracy of the evaluation and detection system of students' classroom attention is 92.17%. It can help teachers improve teaching quality and achieve a good application value for classroom teaching.

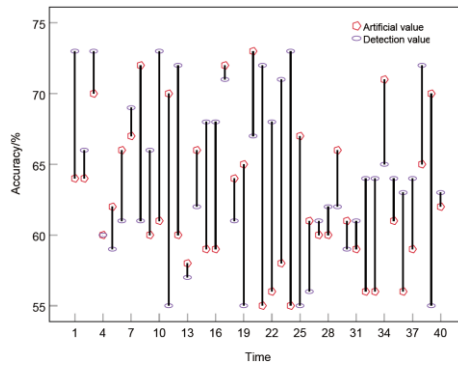


Figure 4: Contrast of attention degree.

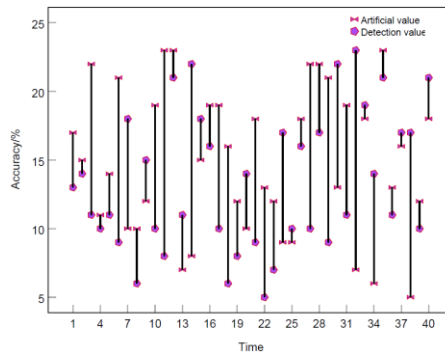


Figure 5: Contrast of doubt degree.

To study the influence of different dimensions of word vectors and other computational layers in the circular attention module on emotion classification results, it conducted here on the effects of emotion analysis of DMN models with different dimensions of word vectors and several computational layers. The accuracy rate is shown in Figure 6.

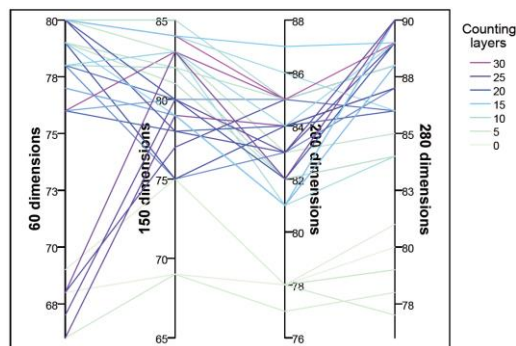


Figure 6: Comparison of model accuracy rates of different word vector dimensions and computational layers.

It can be seen that when the number of computational layers is 14, the classification accuracy rate increases from 69.19% to 77.40% as the dimension of the word vector increases from 50 to 300. This is because high-dimensional word vectors contain more information, which can model words more accurately. When the number of layers is 22 and 25, the classification accuracy increases from 78.40% to 81.03% and 82.69% and reaches the maximum of 82.77% at the 27th layer.

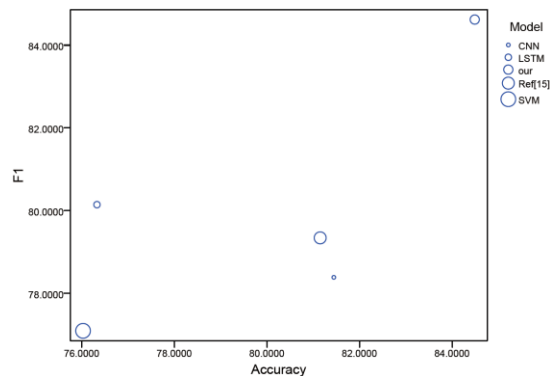
The classification accuracy of the DMN model with a 200-dimensional word vector and five computational layers is compared with other commonly used classical models in five aspects of student evaluation. The results are shown in Table 2.

<i>Project</i>	<i>our</i>	<i>SVM</i>	<i>CNN</i>	<i>LSTM</i>	<i>Ref[15]</i>
<i>Teaching attitude</i>	84.6061	77.5189	81.0935	73.0575	80.5873
<i>Content of courses</i>	82.1302	76.3341	79.125	73.4163	80.6713
<i>Teaching method</i>	82.3349	75.5204	80.5994	75.1485	80.4589
<i>Teaching effect</i>	81.7414	75.5708	77.5749	72.5662	78.8885
<i>Other</i>	83.6311	76.6438	80.8908	72.5691	79.6636

**Table 2:** Comparison of experimental results.

It can be seen that the proposed DMN model achieves a better classification effect than the existing methods, mainly because it can achieve finer-grained emotion analysis for different teaching aspects, which fully reflects the superiority of DMN with prior knowledge in emotion analysis of students' teaching evaluation.

To compare the accuracy of these models and the mean value of macro F1 more intuitively, draw them into bubble charts as shown in Figure 7 below.



**Figure 7:** Comparison between accuracy and macro F1 mean.

Compared with the other four methods, the DMN model achieves the highest average accuracy and macro F1 average in five aspects of emotion classification tasks. The DMN model for judging specific comment aspects has achieved 83.79% classification accuracy.

## 5 CONCLUSIONS

general education integrates the education requirements into the discourse system of professional teachers from the perspectives of moral education, Chinese excellent traditional culture education,

and values education. In constructing a systematic mode of General education, the systematic method points out the overall research method. At the same time, curriculum development and distribution are carried out in all links within the system, which is the systematic cycle of curriculum modules. Take DL as its fundamental pursuit to cultivate students' core literacy. Paying attention to the meaning behind knowledge, cultivating students' mathematical thinking, and grasping the essence of expertise are essential ways to implement core literacy. This paper proposes a DMN with prior knowledge, which combines the previous understanding of comments to realize the aspect-level emotional analysis of students' teaching evaluation. In this paper, the score of the actual entropy function is added to the model as the dimension of time regularity. Finally, the accuracy of the test set rises to 75.036%. Among them, the DMN model for judging specific aspects in comments has achieved 83.79% classification accuracy. As we undertake this endeavor to transform general education by integrating deep learning and Collaborative CAD, we aim to enrich student's learning experiences and contribute to the broader conversation on incorporating state-of-the-art technologies in education. This model is evidence of the potential inherent in pioneering approaches poised to cultivate a new generation of learners with a deep and comprehensive understanding of the world. It has been further proved that the detection method of students' classroom attention evaluation can effectively detect students' classroom learning behavior, and it can help teachers improve the teaching quality and achieve better application value for classroom teaching.

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