

## Research Article

# Analysis of Tai Chi Ideological and Political Course in University Based on Big Data and Graph Neural Networks

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Tai Chi martial arts education is one of the components of school education. Its educational value is not only to require students to master basic Tai movement technical skills and improve their physical fitness but also to bring students' ideological progress and cultivate students to respect teachers and lectures. Excellent moral qualities such as politeness, keeping promises, observing the rules, and acting bravely, as well as the cultivation of the spirit of unity and cooperation, and the quality of will also have a certain meaning. However, the scientific Tai Chi ideological and political courses and the construction of Wude education interactive classrooms lack relevant research. Therefore, this article builds a Tai Chi ideological and political interactive classroom system based on big data technology and graph neural network. First, the spatio-temporal graph convolutional neural network is used to reason about the relationship between Tai Chi action categories and strengthen the low-dimensional features of semantic categories and their co-occurrence expressions used for semantic enhancement of current image features. In addition, in order to ensure the efficiency of the Tai Chi scene analysis network, an efficient dual feature extraction basic module is proposed to construct the backbone network, reducing the number of parameters of the entire network and the computational complexity. Experiments show that this method can obtain approximate results, while reducing the amount of floating-point operations by 42.5% and the amount of parameters by 50.2% compared with the work of the same period, and achieves a better balance of efficiency and performance. Secondly, based on the big data of historical Tai Chi classrooms, this article constructs an interactive classroom system that can effectively improve the quality of Tai Chi ideological and political courses.

## 1. Introduction

At present, the characteristics of martial arts teaching are clearly written in the teaching materials of Tai Chi [1–3] in colleges and universities. The first one is “the ideological education of advocating martial arts and virtue” [4]. Tai Chi martial arts teachers should pay more attention to the ideological education of students in their daily teaching. The requirements of advocating martial arts and advocating virtue in martial arts are reflected. In actual teaching, all of this seems to have not been paid attention by everyone. The current situation of focusing on technical exercises and neglecting cultural teaching in martial arts teaching has led to the fact that the excellent martial arts culture has not been

well continued [5]. How to combine traditional martial ethics with contemporary social development and realize its intrinsic value connection is a problem that needs to be considered at the moment. In the authors' opinion, it is necessary to fully excavate the new elements of moral education in martial arts teaching, to selectively absorb the beneficial parts of traditional martial arts culture, and also to eliminate the parts that are not suitable for social development. On the contrary, it is necessary to base itself on the development reality of culture so that the martial ethics of the new era will have more historical heritage and show the spirit of Tai Chi [6].

From the perspective of “curriculum ideology and politics” [7, 8], this article uses the thrust of “curriculum

ideology and politics” to explore and research the implementation of “curriculum ideology and politics” in college Tai Chi martial arts teaching. It is a good time for inheritance and promotion.

Through the research on the literature and books of Tai Chi Wushu teaching, it can be found that the results of theoretical research are quite rich. However, because the curriculum ideology and politics were put forward in recent years, the teaching concept is relatively new, the research content of martial arts in this field is less, and its related teaching system is not perfect. On the one hand, this research is conducive to broadening the research horizon of ideological and political education, promoting the reform and development of ideological and political education, extending ideological and political education to the martial arts teaching field of physical education, and innovating the exploration and research ideas of ideological and political education in colleges and universities [9, 10]. Political education has been improved in both timeliness and pertinence. On the other hand, it is conducive to perfecting the theoretical system of martial arts education in colleges and universities and makes the martial arts teaching in colleges and universities more cultural connotations. Martial arts is not only a simple technical mastery, but the ideological and political education elements contained in it are extremely rich. The martial arts teaching under the traditional teaching mode is no longer suitable for the development requirements of the current era. Martial arts teaching should keep pace with the times and show its rich cultural connotation and humanistic qualities. With the rapid development of deep learning [11–14], this paper uses big data and graph neural network technology [15–18] to construct an interactive classroom system of Taiji ideology and politics under the perspective of curriculum ideology and politics and realizes the organic combination of teaching Taiji martial arts techniques and guiding the correct values. Following are the main contributions of this paper:

- (i) A novel ideological and political interactive classroom teaching model of Taiji Wushu based on big data and graph neural network: first, collect and organize historical big data for Tai Chi ideological and political classes. Secondly, the graph neural network is used to reason about the relationship between the categories of Tai Chi actions and to strengthen the low-dimensional characteristics of semantic categories and their co-occurrence expressions, so as to improve the teaching quality of Tai Chi ideological and political classrooms.
- (ii) To use the node information integration and update method of the graph neural network model to perform relationship reasoning and information interaction between features to enhance feature expression.
- (iii) An efficient dual feature extraction module to construct the backbone network, and further optimizes the graph model relational reasoning module to reduce the amount of calculation. Finally, a new lightweight encoding enhancement module is

proposed in the codec network structure to ensure that the learned features contain both high-level semantic knowledge and sufficient spatial details.

## 2. Background

Incorporating ideological and political education concepts into the teaching of Tai Chi martial arts, on the one hand, is conducive to expanding the coverage of ideological and political courses, making college ideological and political education face the development of other majors, promoting the integrated development of ideological and political education and college martial arts, and promoting better ideological and political education ground penetration into martial arts teaching; on the other hand, it is beneficial to enrich martial arts teaching content, innovate Tai Chi martial arts teaching methods, and realize the innovative development of skill teaching and ideological and political education in Tai Chi martial arts teaching. At the same time, it also helps students to consciously improve their ideological and political morality and guide them to establish a correct outlook on life and values in a subtle way [19].

*2.1. Courses for Ideological and Political Education.* “Courses for ideological and political education” [20] refers to the in-depth exploration of the ideological and political theory education resources of various courses. All disciplines and courses set by universities must play the role of ideological and political education and build a full process, all-round, and full curriculum from a strategic height. The pattern of educating people enables various college courses and ideological and political theory courses to go in the same direction, forming a synergistic effect, and a comprehensive education concept that always runs through the fundamental task of “building morality and cultivating people.”

*2.2. Education of Tai Chi Wushu in Universities.* Education of Tai Chi Wushu in Universities is a martial arts teaching activity that limits martial arts education within the scope of schools, takes martial arts classes as the main form, and is led by teachers. It aims to enable students to acquire martial arts technical skills, develop students’ intelligence and physical strength, and inherit excellent traditional culture in a purposefully, planned, and organized manner. The education of Tai Chi Wushu [21] in universities referred to in this paper is different from social martial arts and competitive martial arts, which are widely spread in colleges and universities. The ultimate goal of college martial arts is to educate people and cultivate martial arts talents with noble moral qualities and beneficial to social development. The basic content forms of martial arts education in colleges and universities mainly include martial arts classes, martial arts amateur training, martial arts competitions, and extracurricular martial arts activities.

*2.3. Graph Convolutional Neural Network.* The graph convolutional neural network [22] can effectively extract feature information from non-Euclidean distance data. Suppose the

graph data format used is  $G = (V, E)$ , where  $V = \{v_1, v_2, v_3, \dots, v_n\}$  represents the set of nodes in the graph and  $E$  is the set of edges in the graph. Then, the graph  $G$  can be expressed as an adjacency matrix  $A$  of size  $N * N$ . If there is an edge connection between node  $i$  and point  $j$ ,  $A_{ij} = 1$ . On the contrary, if there are no edges connected,  $A_{ij} = 0$ . The adjacency matrix is a representative description of the topological information of the graph in the matrix form. The degree of the node is obtained by summing the elements of each row of the matrix. That is, from the node, there are several edges connected to other nodes, denoted as  $D_i = \sum_j^N A_{ij}$ .

We can define the convolution operation on the graph as the product of a multidimensional signal  $x$ ,  $x \in R^N$ , and a classifier  $g_\theta$ ,  $\theta \in R^N$ , with a parameter  $\theta$  in the Fourier domain.  $Y$  represents the regularized Laplacian moment because the Laplacian matrix has a special eigen-decomposition form:  $L = U\Lambda U^T$ , and  $\Lambda$  is a diagonal matrix composed of the eigenvalues of the Laplacian matrix. Then, the convolutional form of this input signal can be expressed as

$$g_\theta * x = Y g_\theta(L) Y^T x, \quad (1)$$

where  $*$  indicates the convolution process and  $g_\theta(L)$  is a function containing Laplacian eigenvalues. Due to the high computational complexity of the above formula, Chebyshev polynomial fitting is used to simplify its complexity so that  $g_\theta(L) \approx \sum_{k=0}^K \theta_k T_k(L)$ , where  $T_k$  represents the  $k$ -order Chebyshev polynomial and takes  $k = 1$  and  $\theta$  is the Chebyshev coefficient. The final convolutional form of the obtained graph convolutional network is

$$g_\theta * x = \theta(I_N + D^{-(1/2)} A D^{-(1/2)})x, \quad (2)$$

where  $D = \text{diag}(D_i)$ ,  $I_N$  are the unit matrix with the size of the number of nodes  $N$ , and  $I_N + D^{-(1/2)} A D^{-(1/2)}$  can be further simplified as  $D^{-(1/2)} \hat{A} D^{-(1/2)}$ , where  $\hat{A} = A + I_N$ . Through the convolution of the convolution kernel (classifier) and the input signal, the local parameter sharing on the graph structure data can be realized. For the prediction and classification tasks of supervised learning, the result of parameter sharing can be used to judge the similarity between the input data features and the classifier. For unsupervised learning tasks, because the node itself does not have feature information, artificial labels are used in this article to simulate parameters that need to be shared. This artificial tag performs parameter-sharing operations when there are no tags in the surrounding neighbors. In contrast, it is a parameter propagation process.

### 3. Methodology

**3.1. The Basic Connotation of Courses for Ideological and Political Education.** Ideological and political curriculum is to incorporate ideological and political elements including ideals and beliefs, spiritual pursuits, and values in each course so that students will be subtly affected in their thoughts and behaviors on the premise of learning professional knowledge and skills. Through careful combing

and careful analysis of the country's related documents on "Curriculum Ideology and Politics" and the views of some scholars, the authors found that the basic connotation of "Curriculum Ideology and Politics" is mainly embodied in six aspects: cultivating talents, peers in the same direction, all employees' participation, unity of diversity, combination of explicit and implicit, and scientific innovation. First of all, the essence of curriculum ideology and politics is outstanding. "Educating people as the foundation, moral education first," "Moral education" is an ancient topic that keeps pace with the times. Cultivating talents with both morality and ability, integrating "curriculum ideological and political" is to integrate ideological and political content into all disciplines. In the education and teaching of the course, its ultimate goal is to realize morality and foster people. Curriculum ideology and politics adhere to the moral education; first, pay attention to strengthening the cultivation of students' moral quality, and guide students to establish a correct outlook on life and values.

Walking in the same direction is another highlight of curriculum ideology. Ideological and political curriculum requires the same direction and common development of ideological and political courses and other courses. The organic combination of ideological and political education and theoretical knowledge learning is a requirement for educational work in the new era. Ideological and political education is a new concept that puts forward the "double skin" phenomenon of ideological and political work and talent training and is ensuring that the ideological and political curriculum can play a role. Under the premise of educating people, keep pace with other existing courses, strive to realize the unity of teaching and educating people of various subjects, infiltrate ideological and political education into all links of education and teaching work of various subjects, and realize mutual promotion and common development.

**3.2. Tai Chi Recognition.** Tai Chi recognition is a key part of constructing Tai Chi ideological and political interactive classrooms. This section will explain the Tai Chi movement recognition algorithm based on the graph neural network.

**3.2.1. Skeleton Diagram.** The joint points of the skeleton diagram are very important for describing the posture of Tai Chi athletes and expressing body language. It is an important data modality and has important significance, such as behavior recognition in Tai Chi classroom. Figure 1 shows a schematic diagram of the human skeleton.

In mathematics, a graph is defined as a relational structure composed of vertices and edges connecting the vertices. A vertex can represent any research object, and an edge represents a specific relationship between two objects. A graph can be expressed as a set of vertices and edges, denoted as  $G = (V, E)$ , where  $v$  is a set of vertices and  $E$  is a set of edges. At the same time, suppose that the number of vertices in the graph is  $N$  and the number of edges is  $M$ . An edge connecting vertex  $v_i$  is denoted as  $(v_i, v_j)$  or  $e_{ij}$ , as shown in Figure 2(a):



FIGURE 1: Schematic diagram of Tai Chi athlete's skeleton.

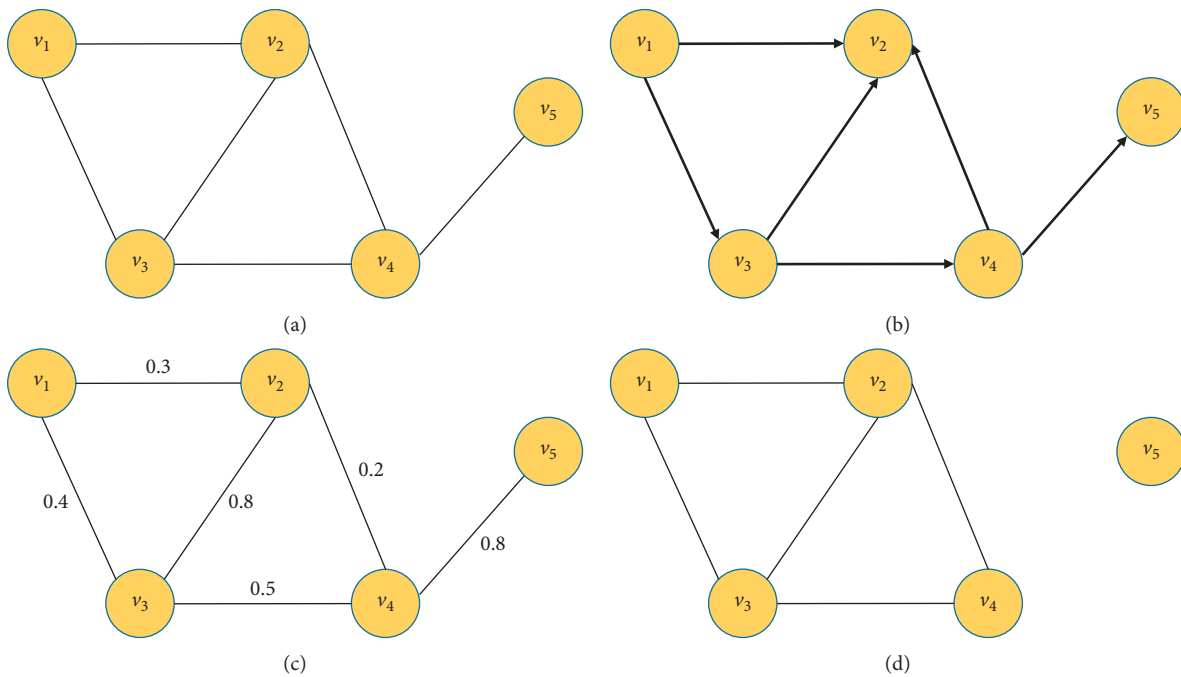


FIGURE 2: Different kinds of graph structures.

$$\begin{aligned} V &= \{v_1, v_2, v_3, v_4, v_5\}, \\ E &= \{(v_1, v_2), (v_1, v_3), (v_2, v_3), (v_2, v_4), (v_3, v_4), (v_4, v_5)\}. \end{aligned} \quad (3)$$

According to whether the edge has directionality, the graph can be divided into directed graph and undirected graph. If the edge in the graph has directionality, then such an edge is called a directed edge  $e_{ij} = \langle v_i, v_j \rangle$ , where  $v_i$  is the starting point of this directed edge and  $v_j$  is the end point of this directed edge. A graph containing a directed edge is called a directed graph, as shown in Figure 2(b). Corresponding to a directed graph is an undirected graph, the edges in an undirected graph are all undirected edges. In fact, an undirected graph can be regarded as a special symmetrical directed graph that contains two directions  $e_{ij} = \langle v_i, v_j \rangle = \langle v_j, v_i \rangle = e_{ji}$ . According to whether the edges are assigned corresponding weights, the graph can be divided into weighted graphs and nonweighted graphs.

Figure 2(c) shows a weighted graph. In actual application scenarios, the weight can be expressed as the distance between the two places or the transportation cost. Under normal circumstances, it is customary to abstract the weight as the strength of the connection between two vertices. Corresponding to it is a nonweighted graph, which can be regarded as a special weighted graph, that is, all weights are equal. In addition, according to whether the vertices are connected, the graph can be divided into connected graphs and unconnected graphs. If there are isolated points in the graph and there is no edge connected to it, it is an unconnected graph; otherwise, there is no isolation. The graph of vertices is called a connected graph. The vertex  $v_5$  in Figure 2(d) does not have any edges connected to it, so it is a disconnected graph.

Given a graph  $G = (V, E)$ , where  $V = \{v_1, v_2, \dots, v_N\}$  and  $E = \{e_1, e_2, \dots, e_M\}$ , the adjacency matrix is defined as

$$A_{ij} = \begin{cases} 1, & \text{if } (v_i v_j) \subseteq E, \\ 0, & \text{else.} \end{cases} \quad (4)$$

Then, the incidence matrix can be defined as

$$B_{ij} = \begin{cases} 1, & \text{if } v_i \text{ is connected to } e_j, \\ 0, & \text{else.} \end{cases} \quad (5)$$

The degree matrix is a diagonal matrix, and the diagonal elements are the degrees of their respective vertices, which can be expressed as

$$D = [d_{ii}], \quad i = 1, 2, \dots, N. \quad (6)$$

Then, the Laplacian matrix is defined as

$$L = D - A. \quad (7)$$

The above three kinds of matrices can be expressed as follows:

$$A = \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix},$$

$$B = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix},$$

$$D = \begin{bmatrix} 2 & 0 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 & 0 \\ 0 & 0 & 3 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}, \quad (8)$$

$$L = D - A = \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} - \begin{bmatrix} 2 & 0 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 & 0 \\ 0 & 0 & 3 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} -2 & 1 & 1 & 0 & 0 \\ 1 & -3 & 1 & 1 & 0 \\ 1 & 1 & -3 & 1 & 0 \\ 0 & 1 & 1 & -3 & 1 \\ 0 & 0 & 0 & 1 & -1 \end{bmatrix}.$$

The skeleton data of Tai Chi athletes is usually represented by the 2D or 3D coordinates of each joint in each frame. From the structural diagram Figure 2(a), it can be

seen that this is an undirected connected graph. Furthermore, in order to be able to capture information in the time dimension, the skeleton sequence is represented hierarchically by constructing a time-space skeleton diagram. The construction of spatio-temporal skeleton graph data is divided into two steps: the first step is to connect the joint points in each frame according to the connectivity of the human body's natural structure. Connect the nodes in the second step, in the time dimension, by doing the same thing between consecutive frames. This connection method does not require any artificial definition, so this network architecture can handle data with different numbers of joints or different joint connectivity. The constructed time-space skeleton diagram is shown in Figure 3.

The set of edges consists of two parts:  $E = E_{\text{intra}} + E_{\text{inter}}$ , where  $E_{\text{intra}}$  represents the connecting edges that connect the joint points according to the natural connectivity of the human body within each frame, which is defined as a

$$E_{\text{intra}} = \{(v_{ti}, v_{tj}) | v_{ti}, v_{tj} \in V_t; i, j = 1, 2, \dots, 16\}, \quad (9)$$

where  $E_{\text{inter}}$  represents the connecting edge between consecutive frames connecting the same joint points, which is defined as

$$E_{\text{inter}} = \{v_{ti}, v_{(t+1)i}\}. \quad (10)$$

Of the two connecting edges, the former can be understood as a representation of the complete structure of the action posture, while the latter can be understood as the motion trajectory of a specific joint point in the time dimension. At the same time, the adjacency matrix can be defined accordingly:

$$A = [a_{ij}], \quad i = 1, 2, \dots, 16; j = 1, 2, \dots, 16. \quad (11)$$

**3.2.2. Spatio-Temporal Graph Convolutional Neural Network.** Spatial graph convolution has made good progress in tasks such as node classification and graph classification. In order to effectively extract spatio-temporal characteristics, it is extended to spatio-temporal graph convolution, which can construct a large amount of real-life data that can be expressed as dynamic graphs. Recalling the convolution operation for 2D images, the input image or feature map can be regarded as a 2D matrix, and the output feature map is still a 2D matrix; at the same time, if the step size is set to 1, plus the appropriate padding operation, the input can be realized. Keep the same size as the output. Given a  $k \times k$  convolution kernel and the input feature map is  $X$ , the output at  $x$  can be expressed as

$$Y(x) = \sum_{h=1}^k \sum_{w=1}^k X(S(x, h, w)) * W(h, w), \quad (12)$$

where  $S$  represents the sampling function, which is used to sample the neighbors at position  $x$  and  $W$  represents the weight function, which is used to generate different weight vectors to calculate the inner product of the sampling input vector. In standard 2D convolution, the weight function has



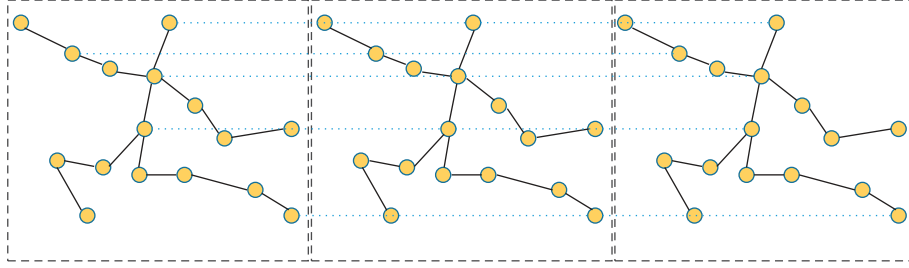


FIGURE 3: Time-space skeleton graph.

nothing to do with the position. Therefore, in the same picture or feature map, the weight is shared. The spatial graph convolution is mainly for the expansion of the sampling function and weight function. In the 2D convolution of the picture, the sampling function is defined as 8 areas of pixels, which can be extended to the graph data. The sampling function can be defined in the node's neighbor node set  $Nb(v_{ti}) = \{v_{tj} | d(v_{ti}, v_{tj}) \leq D\}$ , where  $d(v_{ti}, v_{tj})$  is the shortest distance from node  $v_{ti}$  to node  $v_{tj}$ , specifically for

$$S(v_{ti}, v_{tj}) = v_{tj}. \quad (13)$$

The structure of graph data varies, and the definition of the weight function is one of the main challenges of graph convolution directly applied to the spatial domain. To this end, a weight function based on the labeling strategy is adopted. First, the nodes in the neighbor node set are divided into  $k$  subsets, and then, a digital label is assigned to each subset. The label function is defined as follows:

$$L_s(Nb(v_{ti})) = j, \quad j = 0, 1, \dots, k-1. \quad (14)$$

Therefore, the weight function can be defined as follows:

$$W(v_{ti}, v_{tj}) = W'(L_{ti}(v_{tj})). \quad (15)$$

So the spatial graph convolution can be defined as

$$Y = \sum_{v_{tj}} \frac{1}{Z_{ti}(v_{tj})} X(S(v_{ti}, v_{tj})) * W(v_{ti}, v_{tj}). \quad (16)$$

Based on the above equations, the final output can be expressed as

$$Y = \sum_{v_{tj}} \frac{1}{Z_{ti}(v_{tj})} X(v_{tj}) * W(L(v_{tj})). \quad (17)$$

In fact, there is also the concept of neighbor nodes in the time dimension, and the set of neighbor nodes in the time domain can be defined

$$Nb(v_{ti}) = \left\{ v_{qj} | d(v_{tj}, v_{qj}) \leq k, |q - t| \leq \left\lfloor \frac{\tau}{2} \right\rfloor \right\}. \quad (18)$$

The parameter  $\tau$  is used to control the size of the time-dimensional convolution kernel. In the time dimension, the connection mode of the nodes is relatively fixed, so the label function can be rewritten as follows:

$$L_t(v_{qj}) = L_{ti}(v_{tj}) + \left( q - t + \left\lfloor \frac{\tau}{2} \right\rfloor \right) \times k. \quad (19)$$

Therefore, the calculation form of the single-layer spatio-temporal graph convolution is as follows:

$$Y = \Lambda^{-(1/2)} (A + I) \Lambda^{-(1/2)} XW. \quad (20)$$

**3.3. Tai Chi Ideological and Political Interactive Classroom Framework Based on Big Data and Spatio-Temporal Graph Convolution.** The Tai Chi ideological and political interactive classroom framework based on big data and spatio-temporal graph convolution is mainly divided into Tai Chi ideological and political interactive classroom historical big data analysis, construction of Tai Chi athlete skeleton diagram, spatio-temporal map convolution network feature extraction, classification network, and classroom interaction modules. First, extract the skeleton joint points for the input video frame sequence to obtain the position information of all skeleton joint points and the corresponding estimated confidence score; then, in the spatial dimension, the connection is made inside each frame according to the natural connectivity of the human body, and then, construct a skeleton diagram to connect the same joint points between consecutive frames in the time dimension to construct a time-space skeleton diagram; then, use the space-time diagram convolution to extract the features of the constructed space-time diagram data; finally, use the classification network to identify video clips. The framework of Tai Chi ideological and political interactive classroom is shown in Figure 4.

## 4. Experiments and Results

**4.1. Experimental Environment.** The graph neural network proposed in this paper is implemented by the deep learning framework Pytorch and trained on a workstation equipped with GTX 1080Ti GPU. The entire network is trained for 40 epochs, and the minimum batch training size is 8. The size of the input RGB image and depth image is adjusted to  $256 \times 256$ . Data enhancement techniques such as random horizontal flip, random rotation, and random brightness change are used in the training process to prevent overfitting. The optimizer uses Adam with a weight attenuation of 0.0001, and the initial learning rate is set to 0.0001.

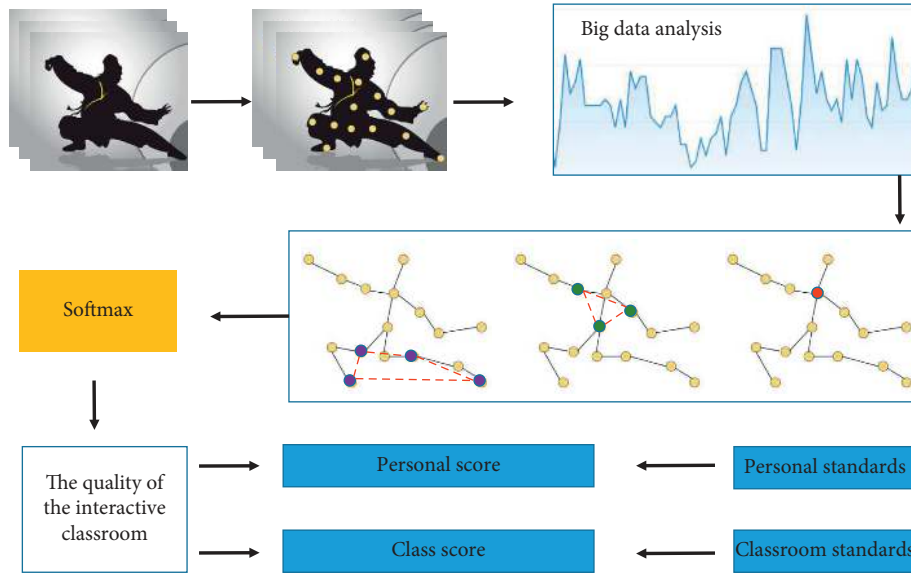


FIGURE 4: The Tai Chi ideological and political interactive classroom framework based on big data and spatio-temporal graph convolution.

4.2. *Dataset.* This paper sorted out and analyzed the big data of historical Tai Chi ideological and political classroom and produced a dataset. Due to the low efficiency of manual labeling of samples, the number of samples in the custom dataset is small, which will cause a certain degree of overfitting. Overfitting will lead to poor performance of the model on the test dataset. In order to avoid overfitting, the model is trained by means of transfer learning. The so-called transfer learning refers to the application of knowledge or patterns learned in a certain field to different but related fields; for transfer learning in deep learning, it refers to the use of previously trained models on related datasets and direct calls. Its structure and network parameters are then applied to a model training method in current research tasks.

4.3. *Evaluation Index.* We mainly use accuracy to evaluate the algorithm, and its calculation equation is as follows:

$$Acc = \frac{TP}{TP + FP} \quad (21)$$

4.4. *Experimental Results.* The experimental results are shown in Table 1 and Figure 5. Among the three models, the highest accuracy rate on the validation set is 79.58%, and the highest accuracy rate on the test set is 78.11%. The method of combining 2D convolution with skeleton joint point features is the worst. The main reason is that 2D convolution and skeleton joint point features are static features. Although the two features are combined, both are spatial information, and sign language actions. Time is a dynamic process that not only contains spatial information but also includes temporal motion information characteristics. In contrast, the recognition accuracy of the 3D convolution model has been significantly improved, and the accuracy has increased by nearly 10%. The reason is that the 3D convolutional neural network increases the feature extraction in the time

TABLE 1: Experimental result.

	2D conv	3D conv	3D conv + transfer learning	Ours
Validation set	60.52	71.56	76.14	<b>79.58</b>
Test set	58.69	65.25	73.26	<b>78.11</b>

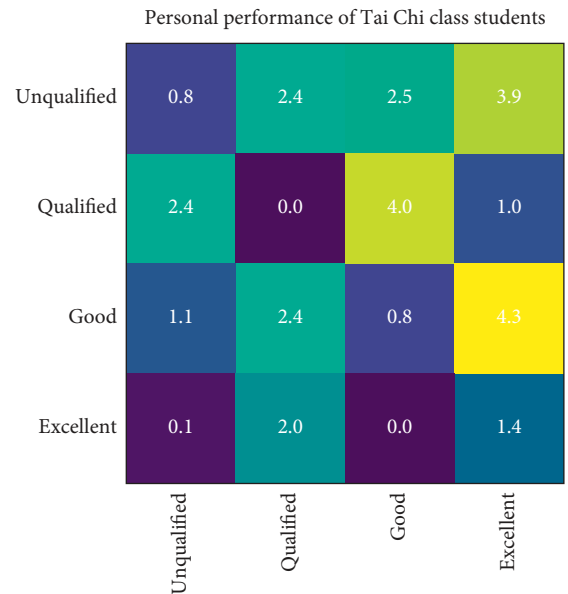


FIGURE 5: Confusion matrix.

dimension so that the final extracted features include not only the spatial structure information but also the changes in the spatial structure information in the time dimension. The skeleton joint point recognition model also considers the skeleton joint point data, but the recognition performance is not as good as the spatio-temporal graph convolution

model, which shows the importance of the information in the time dimension for dynamic feature extraction.

## 5. Conclusion

In this paper, we proposed a Tai Chi ideological and political interactive classroom system based on big data technology and graph neural network. First, the spatio-temporal graph convolutional neural network is used to reason about the relationship between Tai Chi action categories and strengthen the low-dimensional features of semantic categories and their co-occurrence expressions used for semantic enhancement of current image features. In addition, in order to ensure the efficiency of the Tai Chi scene analysis network, an efficient dual feature extraction basic module is proposed to construct the backbone network, reducing the number of parameters of the entire network, and reducing the computational complexity. Experiments show that this method can obtain approximate results, while reducing the amount of floating-point operations by 42.5% and the amount of parameters by 50.2% compared with the work of the same period, and achieves a better balance of efficiency and performance. Secondly, based on the big data of historical Tai Chi classrooms, this article constructs an interactive classroom system that can effectively improve the quality of Tai Chi ideological and political courses.

## Data Availability

The data used to support the findings of this study are included within the article.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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