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Path of innovation and effect optimization of the interaction mode of college Civics classroom based on dynamic data visualization

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Abstract Currently, higher education is facing an important opportunity of digital transformation, and the traditional teaching mode of ideological and political theory class is difficult to meet the learning needs of college students in the new era. In this study, we constructed the interaction mode of college ideology and politics classroom based on dynamic data visualization, and designed a classroom behavior recognition model integrating super-resolution algorithm and 3D convolutional feature extraction. Methodologically, the Moodle platform was used to establish a blended teaching framework, and the FIAS interaction analysis system was used to encode and record the speech behaviors of teachers and students, and combined with computer vision technology to realize the automatic recognition of students' classroom behaviors. Sixty students from University T were selected to carry out the experiment, recording 45-minute teaching videos of the Civics course and identifying five typical classroom behaviors: listening to lectures, writing, raising hands, playing cell phones and drinking water. The results show that the proposed classroom behavior recognition model outperforms the comparison model in both accuracy and mAP metrics, where the mAP reaches 0.925, which is 3.70%, 4.99%, and 2.32% higher than CycleGAN, ResNet, and YOLOv6, respectively. The FIAS analysis results show that the teacher's verbal behaviors account for 60.78% of all the behaviors, the student's verbal behavior accounted for 38.39%, teachers' indirect influence accounted for 21.35%, and direct influence accounted for 39.43%. It is concluded that the dynamic data visualization technology can effectively support the innovation of the interaction mode of Civics and Political Science classroom, which provides scientific basis and technical support for improving the quality of teaching.

Index Terms Dynamic Data Visualization, Civics Classroom, Interaction Mode, Behavior Identification, Teaching Quality, Technical Support

I. Introduction

Civic and political science class in colleges and universities is an important part of university education, aiming to cultivate students' ideological and moral literacy and sense of social responsibility [1], [2]. However, the traditional teaching mode of the Civic and Political Science class often presents the one-way transmission of knowledge, which lacks interactivity and student subjectivity, resulting in students' passive acceptance of education and resistance to the Civic and Political Science class [3], [4]. In order to improve the teaching effect of the Civics class and attract students' interest, the innovation and effect optimization of the interactive education mode of the Civics class in colleges and universities has become an important topic [5].

Interactive classroom teaching mode emphasizes the effective transmission, in-depth understanding and internalization and absorption of knowledge through multi-dimensional interactions between teachers and students, between students and between students and teaching content in the teaching process [6]-[8]. It completely subverts the traditional "duck" teaching, puts students in the center of the stage of teaching, fully respecting the subjectivity and participation of students [9], [10]. The characteristics of interactive classroom are distinctive and diverse, in the interactive Civics class, the teacher is no longer just standing on the podium, but guides the students to discuss in groups and share their personal understanding, so that the students become the protagonists of the classroom, and take the initiative to explore the connotation and practice of the course [11]-[13].

Teachers trigger thinking by asking questions, organize group discussions to promote the collision of ideas, and even invite experts in the field to give online lectures to achieve effective interaction between teachers and students, students and students and students and experts [14], [15]. Similarly, using multimedia technology, teachers transform boring Civic and Political theories into vivid animations and microfilms, so that students can feel the charm of the course in the visual shock [16], [17]. The application of interactive classroom in Civic and Political Education has the advantages of stimulating learning interest and improving learning motivation, cultivating students' critical thinking and innovation ability, promoting emotional communication between teachers and students, and enhancing teaching effect [18]-[20].

Based on the concept of dynamic data visualization, this study constructs an interactive teaching mode of Civics classroom that integrates online and offline, and develops a classroom behavior recognition system by using advanced computer vision technology. The study firstly establishes a blended teaching framework based on Moodle platform, and designs diversified interactive forms including case study, scenario experience, debate and discussion. Secondly, a behavior recognition model integrating super-resolution algorithm and 3D convolutional neural network is constructed to realize accurate recognition of students' classroom behaviors. Finally, combined with the FIAS interaction analysis system, the quantitative assessment of teacher and student verbal behavior is carried out to form a complete evaluation system of classroom interaction, providing technical support and practical guidance for the improvement of the teaching quality of Civic and Political Science courses.

II. Construction of Interactive Mode of Civics Classroom in Colleges and Universities

Whether or not the ideology class can play its due role in establishing morality and educating people depends on whether or not attention is paid to it, whether or not it is adapted to it, and whether or not it is done well. The essence of the Civics course is to reason, pay attention to ways and means, to reason deeply, thoroughly, speak alive, teachers should teach by heart, students should understand by heart, to achieve the communication of the mind, enlightenment, and stimulate the fighting spirit, for the majority of colleges and universities to enhance the effectiveness of Civics course teaching under the new situation points out the direction of work. In the new era when new media technology is changing day by day and has profoundly affected people's existence, life and even way of thinking, the interactive and fast information dissemination is challenging the traditional teaching mode of Civic and Political Science Classes, and there is an urgent need for colleges and universities to explore the new mode of teaching Civic and Political Science Classes under the environment of new media, and to fully mobilize college students to participate in Civic and Political Science Classes with a strong motivation.

II. A. The significance of the interactive model of the Civics classroom

II. A. 1) Interactive Teaching in Civics Classes

Interactive teaching is a teaching mode that emphasizes the interaction between teachers and students and combines theory and practice, that is, teachers and students work together to complete the teaching task in cooperation through mutual communication and exchange. In traditional teaching methods, teachers usually prepare teaching documents before class and arrange course contents according to the teaching plan, but they do not take into account the level of students' ability to accept and digest knowledge, while classroom interaction can ensure that teachers and students have the opportunity to exchange a large amount of information, so that the students' main body status can be reflected, and their needs and personality development can be satisfied. So in recent years, the Civics class in colleges and universities has also introduced the interactive teaching mode into the classroom.

The classroom interaction in the Civics and Political Science course in colleges and universities not only requires that the teachers and students can be integrated with each other, but also requires that the teachers and students have a full understanding of the teaching materials and cases, and be able to skillfully utilize them, and at the same time, the teachers have to observe the interests of the students and give them appropriate guidance. Theoretically speaking, the interactive teaching mode can mobilize the enthusiasm of both teaching and learning, give full play to their subjective initiative, and is conducive to cultivating students' creative thinking [21].

II. A. 2) Principles of Interactive Teaching Models

(1) Make the classroom content “live”. The “interactive” mode of teaching means that teachers guide students to explore the realities and phenomena of contemporary life in depth, so that students can solve the actual case problems in practice, to build an open-ended, practical learning interaction for students, so that students can internalize the theory into self-cultivation.

(2) Let students think and act “move”. In the “interactive” teaching mode, it is not enough to carry out practical teaching only around the Civics classroom, but also around the extracurricular practice part, set up extracurricular learning tasks for the students, such as seminars and surveys, internship reports, etc., so that the students can link theoretical learning with the practice of patriotism, mental health, professionalism and other content.

(3) Let social life be "connected". In the "interactive" teaching mode, teachers should guide students to directly obtain learning experience through social reality and surrounding contradictions, so as to effectively cultivate students' comprehensive ability to solve problems.

Relying on the interactive teaching mode of the Civics classroom can not only improve students' interest in participation, but also enable students to combine their known knowledge and cognitive level with teachers and classmates to discuss and realize the mutual exchange, influence and promotion of ideas, so as to achieve the purpose of teaching and learning, so that the main body of the classroom can effectively promote the students' discursive ability.

II. B.Interactive mode construction of Civics classroom

II. B. 1) Categories of interactive teaching models

Under the background of the new era, there are various teaching modes available to carry out interactive teaching in Civics courses in colleges and universities, such as blended teaching based on information technology and learning characteristics of college students, case study teaching combined with hot topics in the society, experiential teaching based on the real experience of college students, and debating teaching focusing on cultivating the comprehensive quality of college students, etc., which can provide mode choices to carry out interactive teaching in Civics courses in colleges and universities and lead the Civics courses to improve teaching effect effectively through such teaching modes. Civic and political science courses can effectively improve the teaching effect through this kind of teaching mode.

(1) Mixed online and offline teaching. Online and offline hybrid teaching for Civics and Political Science courses in colleges and universities refers to the new teaching mode in which colleges and teachers of Civics and Political Science courses take advantage of the development of Internet information technology to organically integrate traditional classroom teaching with online teaching, which can help Civics and Political Science courses to better utilize the positive roles of the two teaching modes. And respect the status of the main body of learning in the Civics and Political Science course of college students, and better guide college students to carry out in-depth learning in the Civics and Political Science course.

(2) Case teaching. The case teaching method can help the Civics class to respect the status of the main body of learning of college students, and require teachers to select cases related to the teaching content of the Civics class and representative cases according to the syllabus and teaching objectives, and lead students to conduct in-depth analysis and investigation of the cases, as well as guide students to learn the correct interpretation of the cases through cooperation and discussion.

(3) Experiential teaching. Experiential teaching refers to the teaching scenarios set up by the teachers of Civics and Political Science to guide the students to complete the knowledge learning in the scenarios and get the corresponding emotional experience, so as to have a deeper understanding of the theoretical knowledge related to Civics and Political Science.

(4) Debate teaching. Debate teaching requires that teachers of Civics should select a debate theme and determine the arguments for and against according to the content of the course combined with the hot events in the society. And make students according to the debate theme and hold the party to find information, guide students to study the debate in depth, so that they can learn to use the knowledge of Civics and Political Science theory to analyze the problem, solve the problem.

II. B. 2) Interactive teaching mode construction

In the mixed classroom of Civics and Politics based on Moodle platform, teachers, students, technology platform, and environment are the main elements of the mixed classroom, which results in the formation of several types of teaching and learning interactions, including teacher-class interaction, teacher-group interaction, teacher-individual interaction, student-student interaction, teachers' use of technology, students' use of technology, information transfer and communication between technology platforms, teachers' control of classroom teaching tasks, and teachers' management of classroom order. As a result, this paper establishes the interactive teaching model of Civics classroom based on Moodle platform, and its specific framework is shown in Figure 1. In the mixed classroom teaching of Civics based on Moodle platform, it is emphasized that students are the main body of learning and the active constructor of knowledge, and the teacher organizes the teaching and plays the role of a guide in the teaching process [22].

(1) The interaction between teachers and students is a two-way interaction. Teachers play a leading role in the process of student learning through continuous interaction with students, and students also construct knowledge in the process of learning through continuous interaction and feedback with teachers, and the two-way interaction between teachers and students is based on a certain amount of information.

(2) Teachers and technology, students and technology, teachers and students, and students and students communicate and exchange information through technology. Teachers design and organize the teaching content and teaching methods through technology, and design relevant teaching scenarios, while the technology platform provides teachers with a variety of teaching resources and teaching tools, etc., so the interaction between teachers and teaching technology is also bidirectional.

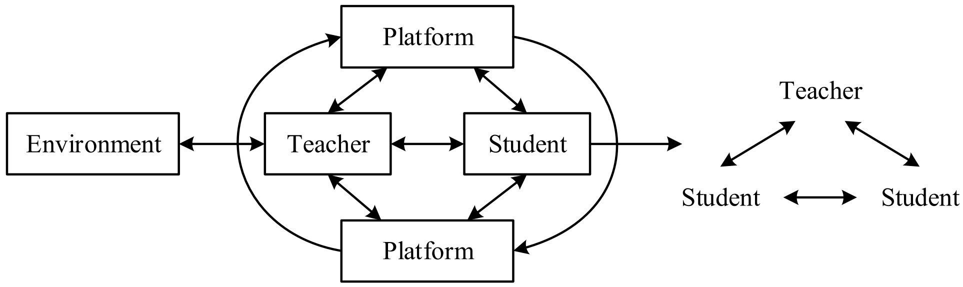

Figure 1: Moodle platform hybrid classroom teaching interaction

(3) Between teachers and the environment, the teaching environment in a mixed classroom includes the physical space teacher environment and the teaching environment organized and managed by teachers. In the physical environment of the Moodle platform, the application of the platform is featured. Teachers and the control of teaching tasks and the management of the teaching order are also two-way interactions, where teachers control the teaching tasks, as well as the next step in the organization of teaching based on the completion of the teaching tasks.

III. Behavioral Identification Model for Civics Classroom in Colleges and Universities

Civics classroom is the main activity place of education, the teacher-student interaction in the teaching process of Civics classroom reflects the students' participation in the Civics classroom and the teachers' control of the Civics classroom, and it is an important part of the digitized portrayal of the overall overview of Civics teaching. It is an important part of the digital portrayal of the overall picture of Civics teaching. It plays an important role in improving the teaching methods of Civics teaching, upgrading the level of Civics teaching, and creating a good teaching atmosphere for teachers. Therefore, combining the existing computer vision technology, deep learning recognition technology and teaching assessment methods to measure the teacher-student interaction behavior in the process of Civics classroom teaching, and forming an objective evaluation and feedback for the teacher's Civics classroom teaching interactions, has an important value for improving the quality of Civics classroom teaching.

III. A. A Behavioral Identification Model for the Civics Classroom

III. A. 1) Framework of the super-resolution algorithm

Super-resolution (SR) techniques aim to reconstruct high-resolution (HR) images from low-resolution (LR) images. The generalized framework for super-resolution reconstruction consists of three key steps: data preprocessing, up-sampling, and reconstruction of high-resolution images. First, the input low-resolution image is preprocessed, such as denoising and normalization. Next, the image size is enlarged by an upsampling layer. Finally, the image is further refined using a complex network structure to reconstruct the details of the high-resolution image.

In the data preprocessing stage, the input low-resolution images are cleaned and prepared with necessary tasks such as denoising, color correction, and contrast enhancement to ensure the quality of the image data. The preprocessing aims to improve the input quality in the upsampling and reconstruction phases, laying the foundation for efficient reconstruction of high-resolution images. The upsampling stage is the core of the super-resolution task, which involves scaling the pre-processed low-resolution image size to a high-resolution target size.

In the post-processing stage, the up-sampled image is further refined and optimized to improve the visual effect of the image. Post-processing techniques include sharpening, de-blocking effects, color correction, etc., which are designed to enhance the visual quality of the image to more closely resemble a real high-resolution image. This stage may also include the use of specific loss functions and optimization algorithms to fine-tune the final output of the image to meet the needs of a particular application. A generalized framework for super-resolution integrates these stages to form a complete process from low-resolution image input to high-resolution image output.

In the field of image super-resolution reconstruction, loss functions are often used to measure the difference between the generated super-resolution reconstructed image and the real high-resolution image, guiding the model to further optimize the generated super-resolution reconstructed image. The common loss functions are as follows:

(1) Pixel-level loss. That is, the difference between two images is compared and analyzed on a pixel-by-pixel basis, including the L_1 loss function and the L_2 loss function, as shown in the following equations:

$$L_1(I,\hat{I}) = \frac{1}{hwc}\sum_{i,j,k} | I_{i,j,k} - \hat{I}_{i,j,k} | \tag{1}$$

$$L_2(I,\hat{I}) = \frac{1}{hwc}\sum_{i,j,k}|I_{i,j,k} - \hat{I}_{i,j,k}|^2 \tag{2}$$

where h,w,c represent the height, width, and number of channels of the image, respectively. In contrast the L_1 loss function is more likely to converge than the L_2 loss function

(2) Content Loss. Image quality assessment based on perceived quality. This metric is commonly expressed as the Euclidean distance between the deep features obtained from the reconstructed image and the real image as input to the pre-trained model. Namely:

$$L_{content}(I,\hat{I};\phi,1) = \frac{1}{hwc}\sqrt{\sum_{i,j,k}(\phi_{i,j,k}^{(l)}(I) - \phi_{i,j,k}^{(l)}(\hat{I}))^2} \tag{3}$$

where h,w,c represents the height, width, and number of channels of the extracted feature map, and $\phi_{i,j,k}^{(l)}(.)$ represents the l th layer of features extracted by the pre-trained network.

(3) The specific formula for the adversarial loss is as follows:

$$L_{Generator}(\hat{I};D) = -\log D(\hat{I}) \tag{4}$$

$$L_{Dtscrt\min ator}(\hat{I};I_s;D) = -\log D(I_s) - \log(1 - D(\hat{I})) \tag{5}$$

where $L_{Gencrutor}$ and $L_{Decriminatr}$ represent the generator and discriminator in adversarial training, respectively, and I_s represents data randomly sampled from real images.

III. A. 2) Classroom Behavior Recognition Model

The flow of the Civics classroom learner behavior recognition model is shown in Fig. 2. The teaching video X after super-resolution is input into the target detection model and 3D convolutional feature extraction module respectively. Among them, the target detection model is responsible for detecting the bounding box of the human body in the video, and after detecting the human body, it carries out attitude estimation, extracts the skeletal feature information of each human body, and obtains the skeletal heatmap of each person F_{ske}^t, which is a two-dimensional information, and its feature dimensions are $K \times H \times W$, K refers to the number of joints, and H and W refer to the height and width of the video frame. The height and width of the video frame. Given the corresponding bounding box, the target heatmap should be zero-filled to match the original frame. When only the coordinates (x_k, y_k, c_k) of the skeleton joints are available, the limb heatmap L can be obtained by combining k Gaussian maps centered on each joint.

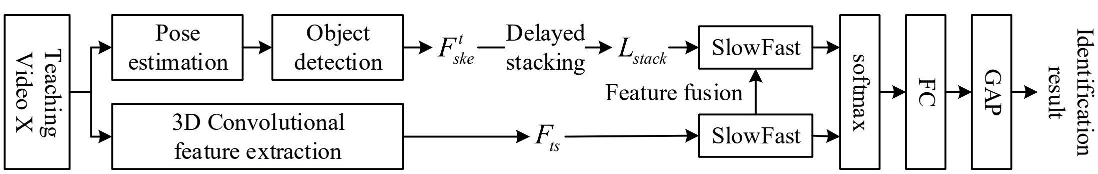

Figure 2: Classroom Learner Behavior recognition model

Its expression is:

$$L_{ijk} = e^{-\frac{D((i,j),s[a_k,b_k]^2)}{2*\mu^2}} * \min(c_{a_k}, c_{b_k}) \tag{6}$$

μ is responsible for controlling the variance of the Gaussian mapping, the k th limb is between the two joints a_k and b_k, and the function $D(\cdot)$ computes the distance from the point (i,j) to the line segments $(x_{a_k}, y_{a_k}),(x_{b_k}, y_{b_k})$ distances. While the above procedure assumes one person per frame, it can be extended to the multi-person case, where the k th Gaussian map of all people is directly accumulated without zooming in on the heatmap. Finally, all the heatmaps are stacked along the time dimension to obtain the 3D heatmap body (L_{stack}), which has the size $K \times T \times H \times W$

The 3D convolution module is responsible for extracting the spatio-temporal features in the video and obtaining the feature F_{ts}, which supplements the feature information due to the human body's occlusion and improves the utilization of features and the accuracy of behavior detection.

After that, after SlowFast's feature processing module, the features are processed in depth, and most importantly, this study deeply fuses the spatio-temporal feature information F_{ts} with the 3D human skeleton information L_{stack}, and finally obtains the behavioral recognition results through the SoftMax activation function, the global pooling layer, and the fully connected layer. The whole process can be described by the following equation:

$$F_{fusion} = SlowFast(L_{stack} \parallel slowfast(F_{ts})) \quad (7)$$

$$out = FC(GAP(Softmax(F_{fusion}))) \quad (8)$$

where "$\parallel$" denotes feature splicing, F_{fusion} denotes the spliced fusion features, FC denotes the fully connected layer, GAP denotes the global pooling layer, and $Softmax$ denotes the SoftMax activation function.

SlowFast employs two modes, the low-speed channel and the high-speed channel, to process the spatial dimension features and the temporal dimension features, respectively. The low-speed channel adopts a lower sampling rate but with a higher number of channels as a way to deal with richer spatial feature information, while the high-speed channel adopts a higher sampling rate with a lower number of channels so that the model focuses more on temporal feature information.

III. B. FIAS Interactive Analysis and Data Sources

III. B. 1) FIAS interactive analysis system

American scholar Flanders proposed a technique for analyzing classroom interaction verbal behavior, the Flanders Interaction Analysis System (FIAS). According to Flanders, verbal behavior is the main behavior of classroom teaching and learning, and language can be explicitly expressed and easily recorded and studied objectively by observers, so the best way to study classroom interaction is to analyze the verbal interaction behavior between teachers and students in the classroom. FIAS codes and then records the language of teachers and students, and analyzes the recorded codes by using a unique matrix analysis form. The FIAS consists of three parts, a coding system for classroom interaction behaviors, rules for observing and recording the codes, and a matrix form for displaying and analyzing the data [23].

The FIAS coding system classifies verbal interaction behaviors in the classroom into ten situations, represented by codes F1-F10, and the content of the behaviors represented by each code is shown in Table 1. In turn, these ten codes are divided into three main categories, namely teacher verbal behavior, student verbal behavior and ineffective verbal behavior. Among the ten codes, F1-F7 are teachers' speech acts, F8-F9 are students' speech acts, and F10 represents ineffective speech acts.

Table 1: FIAS Interactive Coding System

Classification		Code	Content
Teacher's verbal behavior	Indirect influence	F1	Express emotions
		F2	Encourage and praise students
		F3	Adopt students' opinions
		F4	Question
	Direct influence	F5	Lecture
		F6	Instruction
		F7	Criticism
Student speech and behavior		F8	Students answer questions
		F9	Students speak actively
Invalid verbal acts		F10	Silence or chaos

FIAS requires that classroom behaviors be sampled and recorded every five seconds, that the sampled behaviors be coded according to the coding system, and that the codes be entered into the classroom observation recording scale, and that these codes form a sequence of data that represents a series of events occurring in the classroom in chronological order.

After coding all the verbal behaviors of teachers and students in a lesson, the observation recording scale can be organized into a 10*10 data matrix with rows and columns for each of the ten codes in the FIAS. The data in the matrix table comes from the observation scale, two adjacent numbers in the observation record table, as an ordinal pair, the first number in the ordinal pair represents the row and the second number represents the column, and counted once in the corresponding cell in the matrix. Assuming there are N codes, there will be N-1 ordinal pairs.

III. B. 2) Data sources and pre-processing

In order to effectively target the changes in the interactive behavior of teachers and students in the Civics classroom and to make the results of this paper more interpretable, this paper randomly selected 60 students from the first-year students of the School of Marxism of the University of T to carry out the interactive teaching of the Civics mixed classroom based on the Moodle platform. Video recordings were made for the interaction between teachers and students in the Civics and Politics mixed classroom, for which students' classroom behaviors were mainly classified into five categories: playing cell phones, raising hands, writing, drinking and listening to lectures. And their video data were input into the classroom behavior recognition model established in the previous section, which was used to understand the interaction of students in the Civics classroom. Then the coding records were combined with FIAS, and these codes were imported into Excel tables, and finally the curve analysis and matrix analysis of teachers' and students' Civics classroom interaction behaviors were carried out.

IV. Analysis of Interactive Behavior of Civics Classroom in Colleges and Universities

Teachers and students in the Civics class in colleges and universities are the main subjects of education and teaching, and fully studying the subjective status of teachers and students in the Civics class is conducive to the construction of the main interactive mode of the Civics class in colleges and universities. Classroom lecture is the most traditional basic method of Civics classroom, and with the rapid development of information technology, the scientific and technological content of Civics class teaching methods has been significantly improved, and new interactive teaching methods have come into being, which provide a new direction for the innovation and reform of the interactive teaching of Civics classroom in colleges and universities.

IV. A. Identification of Interactive Behaviors in the Civics Classroom

IV. A. 1) State of student behavior in the classroom

The dataset selected for this experiment contains a homemade student classroom behavioral state dataset, which includes five typical classroom student behaviors, i.e., listening to lectures, writing, raising hands, playing with cell phones, and drinking water, i.e., S1~S5. A total of 9,538 images were intercepted from the student classroom behavioral videos, which were divided into the training and validation sets according to the ratio of 7:3. For the classroom behavior recognition model is used the pre-trained model disclosed by the RMPE algorithm is tested directly. During model training, Adam was chosen to update the learning rate, which decreased by 0.001 and 0.0005 for 5000 and 9000 iterations, respectively.To further validate the performance of the model, the next test will be performed on the test set using the weight files obtained after 5000 iterations. This will allow us to assess the performance of the model on real data and determine if it has a better generalization ability.

CycleGAN, ResNet and YOLOv6 are chosen as the comparison models, and the accuracy and mAP are used as the evaluation indexes to obtain the recognition results of different models on students' behavioral states in the Civics classroom as shown in Table 2.

As can be seen from the data in the table, compared with the three models CycleGAN, ResNet and YOLOv6, the classroom behavior recognition model designed in this paper has a greater improvement in the recognition accuracy of five different types of student behavior. This is because the degree of regional division of the five behavioral states is different in the learning of the model. In the model learning, the five types of students showed different behaviors in the classroom. In the learning process, the recognition rate of the behaviors such as using cell phones and raising hands is the highest, because the difference in the degree of distinction between dictation and writing is not large, so the recognition accuracy of both behavioral states is relatively low, while the classroom behavior recognition model designed in this paper reaches a mAP of 0.925, which is 3.70% higher compared to the mAP values of CycleGAN, ResNet, and YOLOv6, respectively, 4.99%, and 2.32%, respectively. Therefore, using the classroom behavior recognition model established in this paper, it can be effectively distinguished for the dynamic data of students' classroom behavior, which can provide support for teachers to grasp the behavioral status of students in the Civics classroom.

Table 2: The identification result of behavioral status

Model	Accuracy rate of various categories					mAP
	S1	S2	S3	S4	S5	
CycleGAN	0.895	0.911	0.886	0.899	0.867	0.892
ResNet	0.882	0.908	0.867	0.892	0.851	0.881
YOLOv6	0.914	0.925	0.895	0.905	0.882	0.904
Ours	0.936	0.947	0.914	0.928	0.898	0.925

IV. A. 2) Analysis of model ablation experiments

In this paper, when constructing the Civics Classroom Behavior Recognition Model, based on the baseline CNN model, the classroom behavior is reconstructed by the super-resolution algorithm (P1), which is input into the 3D convolutional feature extraction module (P2) and goes through the SlowFast feature processing module (P3) in order to achieve the fusion of the classroom behavior features as a way of enhancing the recognition effect of Civics Classroom Behavior. In order to verify the effectiveness of the above three improvement parts, this paper carries out ablation experiments. Precision rate, recall rate, *F*1 and mAP are selected as evaluation indexes, and the ablation training results of the model are obtained as shown in Table 3.

After a comparative analysis to observe the training effect of the model after the introduction of the super-resolution reconstruction algorithm, it can be seen that CNN+P1 has not undergone significant changes in the recall index, but its precision and *F*1 mean have achieved an improvement of 1.59% and 3.43%, respectively. This data illustrates that the introduction of the super-resolution reconstruction algorithm module has positive feedback for model performance optimization, thus demonstrating its effectiveness in the classroom behavior recognition task. The feature fusion part of the improvement experiment is is to deeply fuse the 3D convolutional feature extraction results with the skeletal features, and it can be seen that CNN+P3 has improved in several performance metrics. Specifically, the mean values of precision, recall, *F*1, and average precision of CNN+P3 are improved by 4.82%, 3.76%, 8.64%, and 5.74%, respectively, compared to the baseline model, which demonstrates the effectiveness of the improved method. Combining the three parts of the improvement into this paper's model and comparing and analyzing the four models mentioned above, it can be seen that this paper's model is better than the previous four models in all aspects of precision, recall, F1 value and average precision mean. This explains the effectiveness of the improvement method of this paper to a certain extent, and also provides support for the identification of behavioral states in the Civics classroom.

Table 3: The ablation training results of the model (%)

Model	Precision	Recall	*F*1	mAP
CNN	84.76	86.43	81.64	84.28
CNN+P1	86.35	86.45	85.07	86.16
CNN+P2	88.94	89.62	89.33	89.30
CNN+P3	89.58	90.19	90.28	90.02
Ours	92.15	93.04	92.75	92.65

IV. B. Analysis of Interactive Behavior in the Civics Classroom

IV. B. 1) Teacher-Student Speech Behavior Curve

The teaching video of this Civics course teaching in the College of Marxism in University of T totaled 45 minutes, and the interactive teaching of the Civics course was divided into three segments, namely, introduction, lecture and closing, and the distribution of the speech behavior curve of the Civics classroom teachers and students was plotted based on the original records of the coded recording form of FIAS as shown in Figure 3.

(1) The first 6.5 minutes of the class is the introduction session, accounting for 14.44% of the class time. From the figure, it can be seen that the teachers' and students' speech in the introductory session is basically symmetrically distributed, such as the teacher's speech rises sharply to reach the highest value in the 1st~3rd minutes, while the students' speech drops sharply to reach the lowest value. In addition, teachers' speech is always higher than students' speech, with teachers' speech above 45% and students' speech below 45%. The reason for this was observed that teachers answered questions by name and only a few students had verbal output, resulting in low student speech ratios. The high teacher's speech ratio and the low student's speech ratio indicate that student participation is limited and the teacher dominates the introduction session.

(2) The lecture session mainly lasted for about 34.5 minutes, and teaching activities such as teacher explanation, snatch and answer, reflection and discussion were included under this session. The graph shows that around 12~17

minutes, the teacher's speech showed a decreasing trend, and the corresponding student speech rate showed an increasing trend. At around 25~32 minutes, it is mainly centered on the teacher's explanation activity and the students' discussion of the related Civics content, so that both the teacher's and the students' speech rates show an increasing trend during this period of time. It can be seen that when discussing the activity, the students are discussing while the teacher is guiding them.

(3) The closing session is in the last 4 minutes, occupying 8.89% of the class time, and the teacher ends the Civics course in the form of class summary, class exercises and post-course reflections in the closing session. The figure shows that the teacher-student speech in the closing session crosses for the first time, i.e., the ratio of student speech over teacher speech. It shows that the teacher no longer summarizes or individual students answer in the class summary, but most of the students in the whole class participate in it, which increases the verbal output of the students.

On the whole, the interactive teaching process in the Civics classroom still exists the situation that the teacher's speech ratio is high and the student's speech ratio is low, which should be further optimized and adjusted in the subsequent process, so as to improve the interactive teaching effect of the Civics classroom.

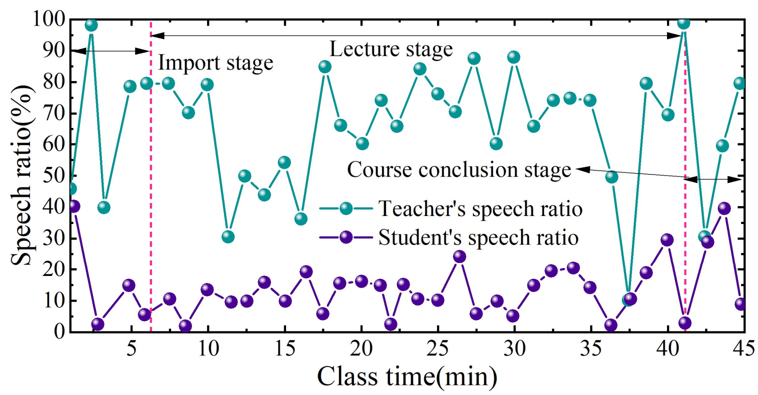

Figure 3: The curve of speech and behavior between teachers and students

IV. B. 2) FIAS interaction matrix analysis

Based on the on-site observation of the Civics classroom as well as the recorded FIAS coded data, a 10*10 FIAS interaction matrix was constructed, and then the results of the FIAS interaction matrix analysis of the Civics classroom were obtained as shown in Table 4.

(1) Teachers' sustained verbal behavior. The cells on the diagonal of the matrix, which represent the sustained behaviors of teachers and students for more than 5 seconds, are called steady state cells. The steady state cell data of this matrix is densely distributed, such as 105 and 311 times of teachers' sustained speech behaviors under (F4,F4) and (F5,F5), respectively. It can be seen that the beneficial teaching silence this type of behavior distribution is the most intensive, the broad pattern of this Civics classroom hearing class is to give students a lot of opportunities to practice, so it leads to the largest data of this type of behavior.

(2) Classroom Atmosphere. Classroom atmosphere can be analyzed and known from the bolded areas in the matrix. The positive integration grid is the area of the matrix where rows F1-F3 intersect with columns F1-F3, and the defective grid is the area of the matrix where rows F7-F8 intersect with columns F7-F8. The more data that fall in the region where rows F1-F3 intersect with columns F1-F3 is an indication of positive integration, indicating emotional harmony between teacher and student. The more data that fall in the defective grid indicates that there is some disconnection between teachers and students in communication.

(3) Teachers' teaching styles and tendencies. The verbal behaviors of category 1 accepting students' emotions, category 2 praising or encouraging students, category 3 adopting or clarifying students' views, and category 4 asking questions belong to the indirect influences exerted by teachers on students, while the behaviors of categories 5, 6, and 7 belong to the teachers' tendency to exert direct influences on students, which belong to the structural behaviors including teachers' behaviors of teaching, giving instructions, criticizing, and asserting authority, and so on. The indirect influence exerted by teachers in this school on students accounted for 21.35% of all speech acts and 39.43% of direct influence, so it can be said that the teachers in this school tended to favor direct teaching style in listening and speaking classes.

(4) Classroom structure. Through the ratio analysis, it can be concluded that the percentage of teachers' verbal behavior is 60.78% of all behaviors and students' verbal behavior is 38.39%, meanwhile the percentage of classroom silence is low only 0.83%. Teachers' verbal behavior is on the high side and the percentage is greater

than students' verbal behavior, but as a Civic Education class, teachers should give the initiative to students and let students discuss boldly instead of speaking in the classroom themselves.

Table 4: FIAS Interaction Matrix Analysis

<table>
<tr><th></th><th>F1</th><th>F2</th><th>F3</th><th>F4</th><th>F5</th><th>F6</th><th>F7</th><th>F8</th><th>F9</th><th>F10</th></tr>
<tr><td>F1</td><td>6</td><td>0</td><td>2</td><td>3</td><td>5</td><td>7</td><td>1</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>F2</td><td>1</td><td>6</td><td>4</td><td>38</td><td>21</td><td>30</td><td>0</td><td>18</td><td>2</td><td>1</td></tr>
<tr><td>F3</td><td>2</td><td>1</td><td>6</td><td>5</td><td>6</td><td>5</td><td>1</td><td>1</td><td>2</td><td>0</td></tr>
<tr><td>F4</td><td>2</td><td>2</td><td>4</td><td>105</td><td>5</td><td>10</td><td>2</td><td>161</td><td>21</td><td>1</td></tr>
<tr><td>F5</td><td>4</td><td>5</td><td>1</td><td>62</td><td>311</td><td>61</td><td>1</td><td>12</td><td>6</td><td>9</td></tr>
<tr><td>F6</td><td>5</td><td>2</td><td>0</td><td>35</td><td>80</td><td>204</td><td>3</td><td>76</td><td>3</td><td>6</td></tr>
<tr><td>F7</td><td>1</td><td>6</td><td>1</td><td>2</td><td>3</td><td>2</td><td>1</td><td>3</td><td>1</td><td>1</td></tr>
<tr><td>F8</td><td>3</td><td>1</td><td>10</td><td>59</td><td>32</td><td>82</td><td>6</td><td>386</td><td>5</td><td>0</td></tr>
<tr><td>F9</td><td>3</td><td>98</td><td>1</td><td>3</td><td>4</td><td>9</td><td>3</td><td>8</td><td>86</td><td>0</td></tr>
<tr><td>F10</td><td>1</td><td>0</td><td>0</td><td>1</td><td>5</td><td>4</td><td>3</td><td>0</td><td>89</td><td>0</td></tr>
<tr><td>Total</td><td>28</td><td>121</td><td>29</td><td>313</td><td>472</td><td>414</td><td>21</td><td>668</td><td>215</td><td>19</td></tr>
<tr><td rowspan="3">Ratio (%)</td><td>1.22%</td><td>5.26%</td><td>1.26%</td><td>13.61%</td><td>20.52%</td><td>18.00%</td><td>0.91%</td><td>29.04%</td><td>9.35%</td><td>0.83%</td></tr>
<tr><td colspan="3">Indirect influence=21.35%</td><td colspan="3">Direct impact=39.43%</td><td colspan="3">38.39%</td><td rowspan="2">0.83%</td></tr>
<tr><td colspan="6">Teacher=60.78%</td><td colspan="3">Student</td></tr>
</table>

V. Conclusion

The Civics classroom interaction model based on dynamic data visualization in colleges and universities can significantly improve teaching effect and student participation. The experimental results show that the constructed classroom behavior recognition model performs well in the recognition of five typical student behaviors, with an overall mAP value of 0.925, among which the highest accuracy rate of 0.947 is for the recognition of hand-raising behavior, 0.936 for the recognition of listening behavior, 0.914 for the recognition of writing behavior, which effectively supports the teachers' real-time control of classroom dynamics.

Through the FIAS interaction analysis, it was found that the interactive teaching in the Civics classroom presents obvious stage characteristics, in which the lecture session occupies the main duration of 34.5 minutes, and the closing session only accounts for 4 minutes, and the problem of uneven distribution of the ratio of teacher and student speech still needs to be further optimized. Teachers' direct influence behaviors accounted for 39.43%, and indirect influence behaviors accounted for 21.35%, indicating that the current teaching mode is still biased towards the traditional teacher-led, and the students' subjectivity needs to be strengthened.

The ablation experiment verifies the effectiveness of each component of the model, and the complete model improves 7.39%, 6.61% and 11.11% in terms of precision, recall and F1 value respectively compared with the baseline CNN, which proves the synergistic effect of super-resolution reconstruction, 3D convolutional feature extraction and SlowFast feature fusion technology.

In summary, dynamic data visualization technology provides a scientific technical path for the innovation of the interactive mode of Civics and Politics classroom, which can realize the accurate monitoring, objective assessment and intelligent feedback of the teaching process, and provides an important theoretical basis and practical support for promoting the teaching reform and quality improvement of Civics and Politics classes.

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