

# Research on the Multi-body Adaptation Path of Collaborative Cultivation of Physical Education Teachers in China

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## Abstract

Based on CAS theory, on the basis of the system characteristics and structure of the adaptive behavior of multiple subjects in physical education teachers, along the process of subject influx and environment historical evolution, we sort out the system operation mechanism and explore the implementation path of collaborative cultivation of physical education teachers. The study concludes that the current collaborative training system for physical education teachers in China consists of four subsystems: the political system, the social environment system, the teaching field system, and the multiple subjects, and that the training process is in line with the dynamic evolution principle of multi-subjects' adaptation, and that the adaptive behavior of multiple subjects is the core driving force of the system's evolution. In terms of the evolution characteristics, operation mechanism, multiple subjects and external environment influence of the physical education teacher system, the collaborative cultivation of physical education teachers should be carried out from the aspects of sound "identification", revitalization of "blocks", smooth "flow", "movement", and improvement of "flow". The collaborative cultivation of physical education teachers should be implemented in terms of sound "identification", revitalization of "building blocks", smooth "flow" and improvement of "self-adaptation".

## Keywords

Physical education teachers; Collaborative cultivation; CAS theory; Physical education integration.

## 1. Introduction

According to the press conference of the Ministry of Education, the number of physical education teachers in compulsory education increased from 502,000 to 595,000 during the "13th Five-Year Plan" period, but in the context of the "Double Reduction" policy and the necessity of "full" physical education classes, the number of physical education teachers has increased to 595,000, and the number of physical education teachers has increased to 590,000. In August 2020, the General Administration of Sport and the Ministry of Education jointly issued the Notice on Deepening the Integration of Sports and Education and Promoting the Healthy Development of Young People, which states: "We should vigorously cultivate a team of physical education teachers and coaches, and smooth the channels for outstanding retired athletes and coaches to enter the schools to serve as physical education teachers on a part-time basis, channels for serving as physical education teachers [1]." By no coincidence, the report of the 20th Party Congress in October 2022 also emphasized taking the socialist core values as a leader and cultivating high-quality and high-level teachers. Therefore, how to strongly support and cultivate high-level physical education teachers is the key to building a strong sports country and promoting the healthy development of young people.

At present, most of the researches related to physical education teachers focus on the directions of core literacy [2] [3], team building [4] [5], pre-service training [6][7], status quo and path [8]

[9] [10], etc, and seldom analyze the structural characteristics and operation mechanism of physical education teacher training from a systematic point of view and a comprehensive concept, which makes it difficult for the research related to the training of physical education teachers to be in-depth and the intrinsic mechanism to be grasped accurately. Along with the development of sports and the integration of sports and education, the main body of physical education teacher training has changed from "one yuan" to "multiple", forming an ecosystem influenced by policy, market and other factors, but the training of physical education teachers is still full of uncertainty [11] Therefore, this paper analyzes the system structure of teacher training based on CAS theory, combs through the process of teacher training changes, innovates the collaborative training mechanism, and puts forward specific implementation paths to provide reference for sports and education departments to develop personalized teacher development planning and teacher training programs.

## **2. Collaborative Training System for Physical Education Teachers in The Perspective of CAS theory**

### **2.1. Brief description of CAS theory**

CAS theory was formally proposed by American professor John H Holland (John Holland) in 1994, which is composed of complex, interacting subjects, relying on the "flow" to achieve the transformation between the elements, and adapting to the other subjects in the environment by changing their own rules and structures in an active or passive form [12]. "Adaptation creates complexity" is the core of the theory, and there are complex non-linear interactions between the subjects within the system, so CAS theory emphasizes the connection between the macro level and the micro level [13]. At the macro level, it is emphasized that the key driving force of the system evolution process is the interaction between the subjects [14]. At the micro level, it is emphasized that the subjects can exchange information and resources, and rely on their own initiative and adaptive ability to respond quickly to external changes, accumulate experience and improve the code of conduct to ensure their own survival and development [15]. Different from previous research paradigms, this theory does not use assumptions to simplify complex problems, but faces up to the complexity of the problem, and explores the intrinsic mechanism of system structure and development under the premise of respecting the imbalance and nonlinear characteristics of the system [16].

### **2.2. The fit between CAS theory and collaborative training system for physical education teachers**

CAS theory emphasizes that the system is a multilevel organization aggregated by multiple subjects, whose subjects rely on material flow, energy flow, information flow stimulation to complete interaction with other subjects and the environment [17]. Aggregation, nonlinearity, flow, diversity, identity, internal model, and building blocks in the theoretical model [18] are necessary foundations of the system and sufficient conditions for the theory [19]. The flow of physical education teachers is affected by the comprehensive influence of the external environment such as policy, society and market [20]. The subjects within the system of collaborative training of physical education teachers are highly compatible with the characteristics of the theory, so the collaborative training of physical education teachers is a complex adaptive system with multiple subjects and multiple levels.

**Table 1.** Physical education teachers' collaborative cultivation highly fit with CAS theory

Theoretical features	Interpretation of Basic Characteristics	Complex Adaptive Characteristics of Collaborative Physical Education Teacher Development
aggregation	The process of individuals interacting to form deeper aggregates, during which the subjects also gradually exhibit a variety of adaptive behaviors	Physical education teachers come from institutional physical education teachers, retired athletes, and other subjects, and the influx of new teachers makes them socially beneficial and forms a complex aggregation
nonlinearity	The interactive process of subject-environment-subject adaptation to change is manifested as a nonlinear state of cross-influence of multiple subjects	Collaborative fostering relies on the adaptive behavior of government, society, schools and other subjects to develop, and neither the subjects nor the fostering model of each subject can be explained by simple linear relationships
flows	The process of realizing the transfer of elements and transmitting substances in the form of material, energy and information flows by each subject	Policies, resources, talents and information are important elements in teacher development, and their relevance and the speed of transformation and interaction between them determine the quality and effectiveness of teacher training
variegation	Due to the different formation conditions and evolutionary process of each subject, the differences between the subjects will gradually expand, which leads to the diversity of the characteristics of each subject, and the aggregation of multiple subjects has become the reason for the diversity of the system	The diversity of collaborative education is manifested in the diversity of subjects and participants, the diversity of contents and qualifications, and the diversity of external environment and operation mechanism, i.e., the sports sector and the education sector have their own development modes and cultivation goals, and naturally, the social evaluation of them and their own operation mechanism are different, and the retired athletes and the physical education teachers in schools have different athletic qualities, differences in skills, and differences in the teaching level
tagging	Tagging is a boundary demarcation standard when subjects are gathered, which can accurately distinguish and categorize different types and levels of subjects.	The elements and subjects within the teacher training system have similar or different characteristics, and the markers can accurately identify the elements and classify them according to the characteristics, so as to formulate clear development goals, precise training methods, and detailed interaction plans and programs
internal models	The system recognizes the input information and judges the output performance to be able to plan the development direction for the main body	Each faculty body has information and energy transferred and exchanged during the process of adaptive behavior, and only by providing the conditions for long-term interaction can it be equipped with the ability to construct internal models; each training sector has unique attributes and management mechanisms, with the ability to identify and anticipate developments as well as to adjust the development plan and formulate countermeasures
building blocks	The independent elements that make up the system, through different combinations of forms, constitute a diverse and complex adaptive system	The participating disciplines, information, resources and other elements of the system are linked together in different combinations, and each element of the system can be viewed as a building block that can be flexibly combined and utilized to make the collaborative PE teacher training system fully developed

### 3. Mechanism for Collaborative Training of Physical Education Teachers

#### 3.1. The Historical Evolution of Collaborative Physical Education Teacher Development

Based on the major events of collaborative training of physical education teachers, combining the emergence of multiple subjects, inter-subject interactions, structural complexity, and the ordering of self-organization and other organizations in the evolution of the physical education teacher education system [21], The evolutionary process of the collaborative training system for physical education teachers is divided into an initial stage, a transformation stage, a development stage, and an innovation stage.

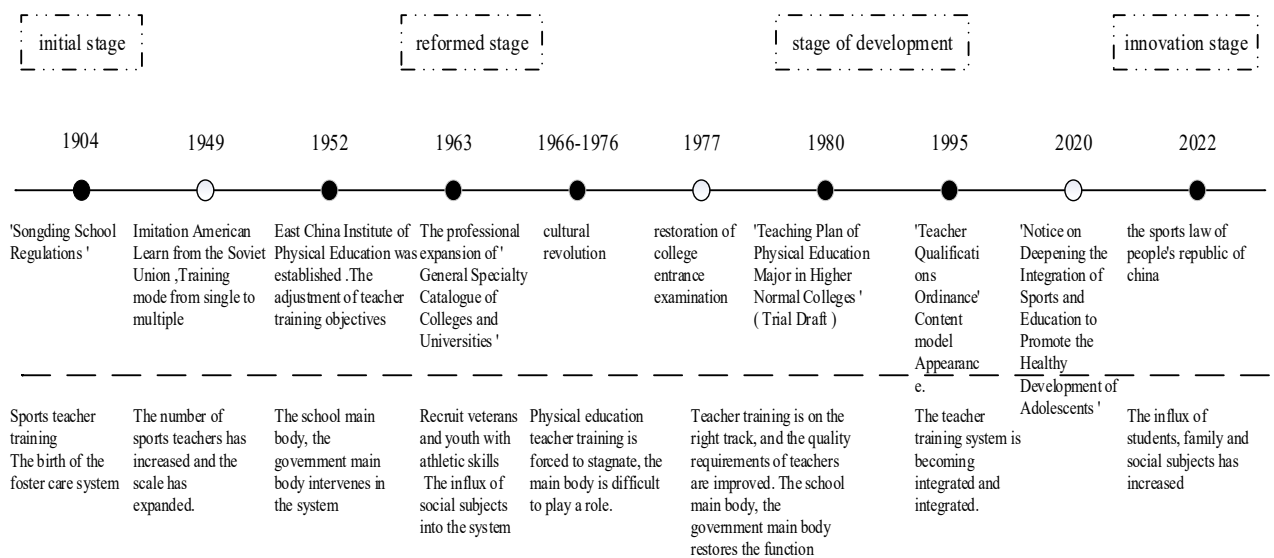


Figure 1. Historical evolution of physical education teacher preparation

#### 3.2. A Complex Adaptive Structural Model for Collaborative Physical Education Teacher Development

The structural model of collaborative training of physical education teachers includes multiple subjects [22] system, Policy [23] system, Socio-environmental [24] systems, Teaching field [25] [26] Systems. Among them, the multi-subject system is the core driving force of the complex system, and its adaptive behavior promotes the development of the system; the policy and institutional system provides policy guarantee, resource layout and action guide for teacher training; the social environment system promotes the strategy of collaborative training and creates a collaborative and shared space; and the teaching field system is an important element carrier, which provides the material foundation for the collaborative training of physical education teachers.

#### 3.3. Complex Adaptive Operational Mechanisms for Collaborative Physical Education Teacher Development

In the process of system operation, the structure and function of the subjects within the system and between the subjects and the environment are not consistent, but the subjects and between the subjects and the environment show interaction and synergy. Changes in the behavior of any subject can be regarded as changes in the external environment of other subjects, and when receiving signals from the external environment, the subject reacts in time to achieve adaptation to the environment [27], For example, the government emphasizes the integration of sports and education, and promotes the behavior of excellent athletes and coaches as

teachers, which gets the common attention of multiple subjects, and then each subject identifies the external environment and adjusts its own behavior to adapt to the environmental changes, and the mobility of multiple subjects in this process strongly promotes the evolution of the collaborative training system for physical education teachers.

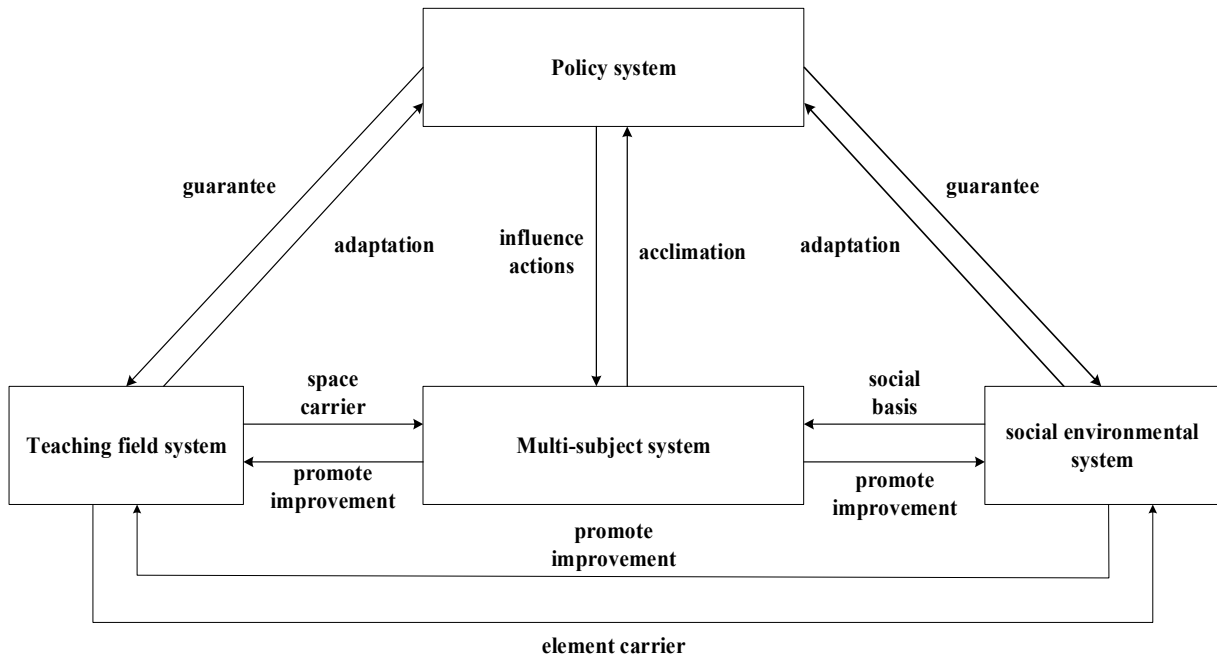


Figure 2. Physical Education Teacher Collaborative Development Complex Adaptation

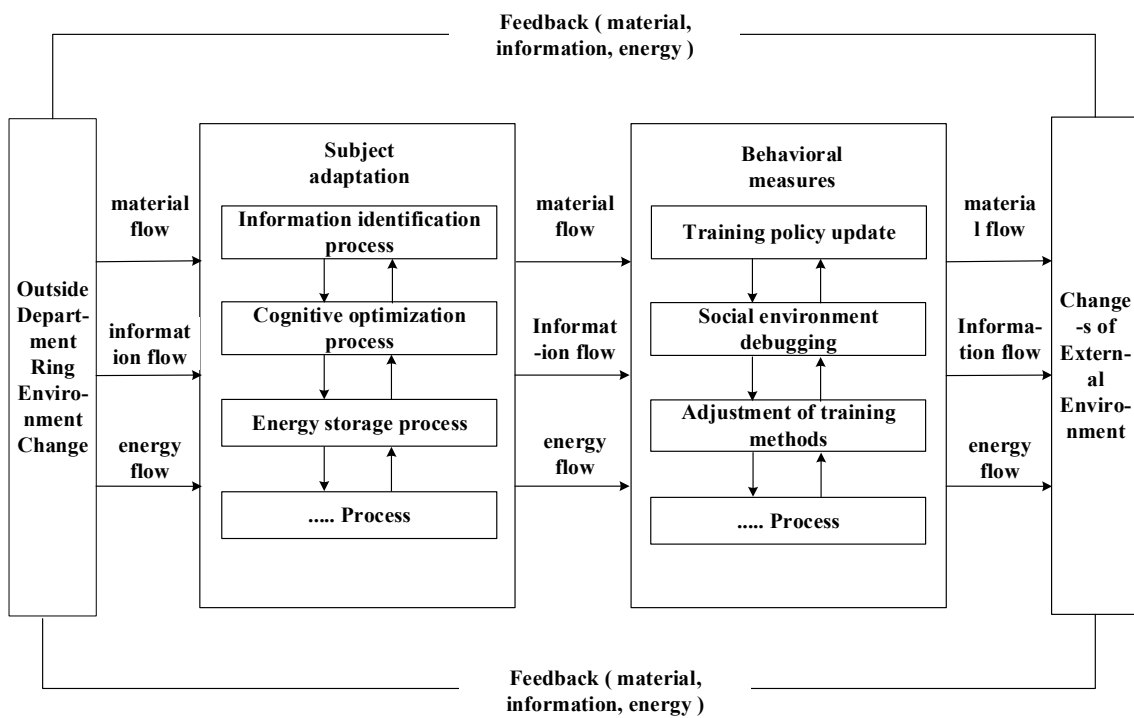


Figure 3. Complex Adaptation Model for Collaborative Physical Education Teacher Development

Overall, this process is both a dynamic embodiment and a passive reaction process, and runs through the beginning and end of the collaborative training of physical education teachers.

Based on the interests and competitive development of each subject, it contributes to the continuous strengthening of positive feedback and weakening of negative feedback in the system of collaborative cultivation of physical education teachers, promotes the effective promotion of collaborative cultivation of physical education teachers, and contributes to the complex adaptability of the participating subjects in the system of collaborative cultivation of physical education teachers.

#### **4. Pathway for the Implementation of Collaborative Training of Physical Education Teachers**

Understanding the system structure and operation mechanism of collaborative training of physical education teachers and fully exploring the intricate relationship between the subjects and between the subjects and the environment are fundamental to its development. Among them, the ability of multiple subjects to adapt to changes is the core driving force of the system evolution, the interaction between subsystems and elements is the basic driving force of the system evolution, and the clear "tagging" is the auxiliary driving force of the system evolution.

##### **4.1. Sound "tagging" and clarification of the basic objectives of the main lines at all levels**

"tagging" is a basic feature of the system, playing an important role in the process of system evolution, layering and leading, which can help the subject to identify and filter, and achieve the purpose of clear goals [28].

First of all, it is necessary to set up the correct value markers. The overall control of the system should be based on the in-depth interpretation of the policy outline, and with the "socialist core values as the leader of soul cultivation" put forward by the 20th National Congress of the Party as the core orientation, make full use of the advantages of retired athletes themselves, and guide the athletes to enter colleges and universities to receive higher education, and then finish their studies to complete the role transition from athletes to physical education teachers, and become "dual-teacher" physical education teachers. Athletes to the role of physical education teachers to become "dual-teacher" physical education teachers. Secondly, a sound and perfect supporting policy system should be identified. Departments at all levels should provide qualified physical education teachers to meet the development of mobility and security measures, for example, the Chengdu Municipal Sports Bureau, the Municipal Public Security Bureau and the Municipal Bureau of Human Resources and Social Security jointly issued the "Notice on the certification of athletes and referees coming to hometowns in Chengdu" to further improve the introduction of sports talent channels [29]. Finally, a good cultural identity should be shaped. Create a good employment environment and social recognition for retired athletes, prioritize the development of human resources, publicize and advocate the advantages and strengths of the athlete-teacher community, and extinguish the flames of social prejudice.

##### **4.2. Revitalizing "building blocks" and strengthening interactions among multiple actors**

Nonlinear interactions between elements are the essence of the complexity of systems and are prevalent within and between systems [30]. The system of collaborative training of physical education teachers has obvious non-linear characteristics among the subjects, and the system is composed of multiple subjects, multi-sectoral and multi-level elements within the system.

First of all, as a key link connecting retired athletes, schools and society, the sports department should break through the curing of single development, actively innovate the main linkage mode, fully mobilize the system's external resources to provide retired athletes with traineeships and internships, and establish a network of cooperation and a working platform for career change. Secondly, provincial and municipal sports departments and education



departments should strengthen the linkage, comprehensively find out the status quo of the development of local sports education undertakings, establish and improve the information service platform for retired athletes to teach, and provide the latest policy release information, job recruitment information, interview guidance information and other services. At the same time, the sports and education departments should join hands with the social security departments in order to make a good connection between retired athletes' teachers' wages and salaries, compensation and subsidies, teaching and training, and other aspects. Finally, the subsystems should actively promote the "building block" multiple combination approach to form a new internal model, i.e., to strengthen the top-level design of the collaborative training of physical education teachers and the direction of the work, to enhance the local allocation of funds, and to provide support for equipment and training for retired athletes to schools that employ or receive retired athletes to engage in extracurricular physical education counseling and training activities, and to provide support in terms of equipment and training for competitions. The education sector should also conduct in-depth explorations on how to provide support for emerging athletes. The education sector should also conduct in-depth explorations of collaborative teacher training programs with special characteristics for emerging teacher subjects, and establish a monitoring and feedback mechanism in collaboration with social organizations to ensure that feedback results can be obtained from multiple perspectives and diversified perspectives.

#### **4.3. Smooth "flow" to break down the original barriers to training subjects**

Theory suggests that "flow" refers to the flow of materials, information, resources, talents, etc., between subjects and between subjects and the environment to complete the process of interaction [31]. Smooth "flow" movement, can effectively promote the transformation speed between the main body of the system, promote the evolution of the system.

First of all, the governmental body should collaborate with the participating bodies to actively carry out teaching training and symposiums to improve the interoperability of physical education teachers in terms of technology, knowledge, teaching and other abilities; and jointly carry out activities such as job fairs and supply and demand fairs with the physical education and education departments to help retired athletes master the skills and methodology of teaching and open up the channels of job-seeking by providing athletes with job-training opportunities, employment and job-seeking guidance, and other services. Secondly, the implementation of the integration of sports and education has been promoted in an all-round way. Enhance the degree of integration between the sports and education sectors in terms of cultivation concepts and methods, sharing of resources and talents, etc. Through the teaching process, athletes can be highlighted on campus in the post-sporting period, and correct values can be passed on to young people. In addition, we should strengthen the information and energy interaction between emerging sports teachers and school physical education teachers, encourage retired athletes' teachers and original school physical education teachers to participate in vocational skills appraisal on the basis of mutual learning, and increase the free vocational skills training for physical education teachers, so as to make up for the deficiencies of the emerging teachers in the teaching of a number of sports skills. Finally, establish a sharing mechanism for resource mobility. Local governments can reduce the qualification threshold, actively implement the outstanding retired athletes should be free of written exams for teachers and "first on the job, after the examination", or to take the first into the coaching staff, in service during the successful acquisition of teaching qualifications will be hired to absorb talent, dredge the obstacles to make up for the athletes employment and sports teachers to make up for the lack of double shortfalls.

#### 4.4. Improvement of "self-adaptation" to achieve self-regulation by subjects

"Adaptive" refers to the ability of subjects in a system to adapt to their environment through purposeful "learning" [32]. The complexity of the multiple subjects in the collaborative training of physical education teachers is such that by improving the ability of "self-adaptation", the subjects will be able to move forward in the collaborative process.

First of all, the government should always keep abreast of the times, focus on strengthening policy guidance and direction, while always maintaining close contact with other subjects, coordinating urban and rural areas and improving the supply and demand system of school sports, giving full play to the advantages of retired athletes in sports-specific skills, and making use of the sports talent service organizations to provide good employment services for the emerging teachers. Secondly, sports departments at all levels should give full play to the role of undertaking and linkage in the system, and fully implement the mechanism of guaranteeing high-quality talents, resources, welfare and information flow to improve the cultivation of athletes' talents, and assist retired athletes in teaching to avoid the employment risk; sports and education departments at all levels should increase the communication and coordination with the departments of human resources and social welfare and civil affairs, and assist in solving the problem of retired athletes teaching in the sports system who are still in the system. The sports and education departments at all levels should increase communication and coordination with human resources and social departments and civil affairs departments to help solve the problem of retired athletes still staying in the sports system. Finally, when athletes stop training, they should respond quickly and give career guidance through team counseling, vocational psychological counseling, psychological adjustment and other forms to strengthen athletes' ideological awareness and enhance their confidence in career change and adaptability.

### 5. Conclusion

In the new era, under the guidance of the concept of integration of physical education and sports, school physical education plays an all-round role in promoting young people to enhance their physical fitness, improve their personality and exercise their will, while physical education teachers shoulder the responsibility of promoting the healthy development of young people and shaping elite sports talents, so the importance of in-depth investigation of the collaborative cultivation of physical education teachers is self-evident. The complex adaptive system provides a new theoretical perspective for the collaborative cultivation of physical education teachers. By analyzing the different historical characteristics embodied in its policy system, multiple subjects system, social environment system, and teaching field system under the stimulation of different external environments, the future cultivation of physical education teachers should be based on the overall situation, and should be led by the socialist core values to optimize the adaptive status of the policy system, the social environment, the teaching field, and the multiple subjects, and to continuously optimize the adaptive status of the policy system, the social environment, the teaching field, and the social environment. adaptation status of multiple subjects, continuously optimize the system of physical education teacher training, provide inexhaustible power, promote the reform and innovation of collaborative training of physical education teachers, and promote the high-quality development of teacher level.

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