

# Construction and Application of PE-PCK Characteristic Training Case Teaching Model for Excellent PE Teachers based on Artificial Intelligence Technology

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## Abstract:

In order to improve the quality of physical education teacher training, with the help of artificial intelligence technology, this study constructs and applies a case teaching model based on the PE-PCK characteristics of excellent physical education teachers. The feasibility of the case teaching model in the construction of this characteristic is demonstrated, and the PCK of normal students and excellent physical education teachers is compared and analyzed. Based on the content, characteristics, and construction path of PE-PCK for excellent physical education teachers, a case teaching model for PE-PCK excellent characteristics training of normal students is established. Selecting physical education teacher students from Qujing Normal University for implementation, analyzing the results of the formation of PCK in the curriculum before and after implementation, verifying the effectiveness of constructing excellent physical education teacher PCK characteristics for teacher students, and improving the model through interviews. The results indicate that this model helps teachers accumulate teaching cases, enhance their ability to promote student development, educational theory literacy, and subject teaching theory knowledge.

**Keywords:** P.E. normal students; case teaching; PCK; artificial intelligence technology.

## INTRODUCTION

The PCK characteristics of excellent P.E. teachers include higher education theory accomplishment, mastery of PE teaching theory knowledge, accumulation of rich teaching cases, more targeted selection of teaching strategies, more effective design and implementation, and creative teaching, [1] which can be used as directions in the PE-PCK excellent characteristics cultivation for normal students. Relevant experts demonstrate that case teaching is an important way to cultivate PE-PCK of normal students, but can case teaching promote the cultivation of excellent P.E. teachers' PCK characteristics of normal students? How can it promote? These contents need to be further demonstrated and tested. Artificial intelligence technology can effectively collect these materials, provide rich matching resources for education and teaching, and use online education platforms to understand learning dynamics, interact randomly with students, evaluate students' learning effectiveness, etc. This provides conditional support for studying the effectiveness of case-based teaching models and improving case-based teaching. In view of this, based on the content, features, construction path of PE-PCK of excellent P.E. teachers and the existing case teaching discourse, and the existing argument that PE-PCK of P.E. teachers can be cultivated in different stages, this paper demonstrates the feasibility of case teaching mode to promote PE-PCK for normal students, and reconstructs and verifies the case teaching mode with the guidance of excellent characteristics, so as to promote the construction of PE-PCK content of excellent P.E. teachers for normal students.

## OBJECTIVES

The main purpose of this study is to construct a teaching model for cultivating excellent teacher traits in physical education teacher trainees, providing teaching references and inspirations for cultivating high-quality teacher trainees.

## METHODS

Taking the Construction and application of PE-PCK characteristic training case teaching model for excellent PE teachers as the research object, this paper demonstrates the feasibility of using the case teaching model in the construction of the excellent physical education teacher PE-PCK for teacher students, and constructs an excellence oriented case teaching model for physical education teacher students based on the content, characteristics, and construction path of the excellent physical education teacher PE-PCK.

Compare and analyze the results of the implementation of the excellence oriented case teaching model for physical education teachers before and after the formation of students' physical education teaching knowledge, and verify the effectiveness of this case teaching model in constructing the PE-PCK characteristics of outstanding physical education teachers for physical education teachers.

After the theoretical model was formed, it was applied in the course of "Analysis of Middle School Physical Education Textbooks" for 55 students in the experimental class of physical education major in 2019, and the effectiveness of the case teaching mode for PCK training of physical education normal students under the guidance of excellence was investigated to understand the effectiveness of this mode.

In the process of implementing case studies, after using case teaching, interviews are conducted on the selection and presentation of cases, the handling of teacher-student relationships, and the organization of teaching. Students' preferred and effective teaching methods are selected to continuously improve the case teaching mode.

## RESULTS

Result 1: Case teaching can effectively promote the development of excellent physical education teacher PCK traits among normal students, and the traits of excellent physical education teachers can be cultivated across different stages.

Result 2: The teaching model of case preparation presentation discussion analysis evaluation reconstruction guided by constructivism and PCK theory can help physical education teacher students accumulate rich teaching cases, improve their educational theoretical literacy, and acquire theoretical knowledge of subject teaching.

## DISCUSSION

### Feasibility of Case Teaching in Excellence-Oriented Cultivation of P.E. Teachers

#### *Case teaching meets the requirements of PE-PCK excellent characteristics cultivation of P.E. teachers*

In 2014, the Ministry of Education clearly pointed out in its Opinion on the Implementation of the Excellent Teacher Training Program to train a large number of high-quality and specialized primary and secondary school teachers with noble morality, solid professional foundation and excellent teaching and self-development abilities.[2] The research on excellent teacher training reveals that the decisive factors for the growth of excellent teachers are personal learning, teaching reflection, teaching interaction, expert guidance, teacher guidance, peer assistance and leadership support, etc.[3] Case teaching is a teaching method in which students analyze and discuss specific and typical cases of certain knowledge or problems under the guidance of teachers. It is not only a process of interaction between teachers and students, students and students under the guidance of teachers, but also a process of promoting students' continuous reflection, self-knowledge construction and problem-solving ability. Moreover, it can also provide scenes such as learning, reflection, interaction, expert guidance and peer assistance for the cultivation of excellent teachers, and it is highly consistent with the individuality, situationality and practicalness of the formation of P.E. teachers' PCK, which is in line with the requirements of individuals who receive the cultivation of excellent P.E. teachers' core literacy PCK knowledge to reflect and construct their own knowledge in the teaching scene.

#### *The cultivation of PE-PCK excellent characteristics for P.E. normal students needs a lot of case accumulation and creation*

P.E. normal students are the pre-service stage of training P.E. teachers, and training P.E. normal students to be an excellent P.E. teacher requires continuous learning, reflection and accumulation of experience before, during and after the job. However, consciously and purposefully guiding students to be excellent at this stage can lay a good foundation for students to grow into excellent P.E. teachers. A review of the training objectives of pre-service teachers shows that pre-service P.E. teachers should focus on improving the knowledge structure of future excellent teachers and training their discipline and teaching ability [4].

In the process of studying the quality content and outcome indicators of excellent P.E. teachers, Standards and Guidance for Professional Development of Primary and Secondary School Teachers-Physical Education and Health clearly points out the outcome indicators of teaching and PCK from a mature to an excellent teacher [5] (as shown in Table 1), which provides guidance for the targeted cultivation of P.E. teachers' PCK. The outcome indicators clearly put forward the requirements of rich teaching cases for excellent P.E. teachers, as well as setting up creative cases. Obviously, case teaching is essential in the cultivation of excellent P.E. teachers.

#### *The selection and target orientation of implementation curriculum under case teaching*

*Analysis of PE Teaching Materials in Middle Schools*, a required course for physical education major that combines teaching theory and practice closely, is a normal education course specially set up for physical education, which can not only cultivate students' professional knowledge of disciplines, but also cultivate students' teaching knowledge and skills of disciplines. In the implementation of teaching, there are both teaching hours for teaching theory and teaching practice, so that students can acquire the theory from teaching practice, and apply the theory to practice, so as to enrich and improve their teaching knowledge and ability.

A review of the current research on case teaching in the field of physical education (Table 2) shows that case teaching can be applied in *School Physical Education, P.E. For Middle Schools, Micro-training of Physical Education Teaching Skills* and the teaching classes of sports events in physical education practice courses, and has the values of case accumulation and promotion of reflection, improvement of teaching theory literacy and formation of teaching philosophy required by excellent P.E. teacher PCK.

**Table 1. The outcome indicators of teaching and PCK from a mature to an excellent teacher**

Standards	Outcome indicators
Teaching and PCK	A high educational theory literacy.
	The mastery of the theoretical knowledge of physical education teaching, the accumulation of rich teaching cases, the ability to refine and summarize teaching experience and the formation of characteristic teaching ideas.
	The ability to choose appropriate teaching strategies according to specific teaching contents and teaching objects, and creatively impart knowledge and exercise methods to students through effective teaching design and classroom teaching, so that each student can truly feel the ability of physical education to promote their growth.

**Table 2. Research on the use of case teaching in the field of physical education**

Scholars	Values
Shi Xiaojun, Zhang Huaguang [6]	It is helpful for teachers to implement advanced teaching concepts into specific classroom teaching behaviors, to improve teachers' reflective ability in teaching practice, to promote their professional growth, and to improve the effectiveness of their teaching and research activities.
Huang Zhongqiang [7]	It can more effectively achieve the teaching objectives of the <i>School Physical Education</i> course, promote the professional growth of subject teachers and improve the teaching quality.
Yu Xiao, Ma Zhijun et al. [8]	It can improve students' attention and interest, and cultivate students' independent innovation and self-analysis ability.
Ren Xiaofeng [9]	Through the interaction between teachers and students to achieve mutual benefits in teaching, it fully mobilize the initiative and enthusiasm of students, and improve the efficiency of classroom teaching because it is vivid and specific.
Yang Jiefu [10]	It can promote students' mastery and understanding of knowledge, inspire students' thinking and improve their ability to apply knowledge, thus improving the overall teaching effect.

Guided by the outcome indicators of excellent P.E. teachers, combined with the relatively poor professional knowledge, education and teaching knowledge of Grade 2019 students, and according to the content of specialized course textbooks and the role of case teaching in related courses, the objectives can be positioned as follows: to be able to actively learn the professional theoretical knowledge and teaching knowledge of middle school physical education, choose appropriate teaching strategies according to specific teaching contents and teaching objects, and effectively implement teaching design and classroom teaching; to have rich teaching cases in actively participation in the accumulation, analysis of cases and reflection and reconstruction of cases, and to create cases that promote students' growth.

### Construction of Case Teaching Model for Normal Students in PE-PCK Excellent Characteristics Cultivation

#### *Definition of case teaching model for normal students in PE-PCK excellent characteristics cultivation*

According to Xu Yanning [11], the theoretical basis of case teaching is transformative learning theory, information processing theory, teaching communication theory and insight learning theory, etc. Moreover, the case teaching model for normal students in PE-PCK excellent characteristics cultivation should also be based on constructivism and PCK theory. On the one hand, the formation of subject teaching knowledge of P.E. normal students is a process of construction combined with their own knowledge and experience; on the other hand, the case teaching is a teaching method in which specific cases from PE teaching practice are selected, teachers and students use targeted teaching theory knowledge to analyze and study the PE teaching situations presented

in the cases, sort out the elements and relationships of the cases and try to put forward solutions, and construct the cases to improve students' PE-PCK knowledge and problem-solving ability, thus laying the foundation for their core literacy to become excellent P.E. teachers. Therefore, the case teaching model for normal students in PE-PCK excellent characteristics cultivation is the teaching process of cultivating the PCK content of excellent teachers for P.E. normal students under the guidance of excellent P.E. teachers' PCK content and in accordance with the case teaching theory, constructivism and PCK theory by using the case teaching mode.

#### ***Implementation process of case teaching model for normal students in PE-PCK excellent characteristics cultivation***

The implementation of case teaching usually consists of case preparation, case presentation, case discussion, analysis and evaluation. In order to cultivate the PCK knowledge of P.E. normal students, targeted teaching cases should be selected for presentation, analysis and evaluation during the implementation of the original case teaching. Besides, to better cultivate the PE-PCK excellent characteristics, it is also necessary to increase the links of students' practice teaching by reconstructing or simulating teaching cases, further deepen the combination of students' theory and practice, integrate advanced teaching ideas into teaching actions, promote students' reflection and innovation, help students form advanced teaching ideas and thoughts, accumulate teaching cases, and build PCK knowledge required by excellent P.E. teachers.

During the case collection and preparation, targeted typical teaching cases should be selected to reproduce the application of theory in physical education practice, so that students can combine theoretical knowledge with teaching practice scenes to form their own practical teaching experience. In addition, diversified cases should be selected, such as those that adhere to the principles of physical education and those that do not reflect the principles of physical education, as well as written cases, image cases, audio cases, etc., so that students can perceive the scenes in which theories are applied in physical education from different levels and accumulate personal teaching cases and experience.

In the presentation of cases, physical education teaching cases can be presented first, then related theoretical knowledge can be linked to discuss questions about the cases, and then students can be guided to analyze and reflect on the cases and discover the theoretical knowledge of physical education teaching applied in the case teaching practice. Because such in-depth study based on PE teaching research can enable students to discover and solve problems in case analysis and exploration, discover the applied theories in the PE teaching practice presented by the cases, and direct the creation of practical cases according to the correct thinking of applying the theories, so as to closely link the PE teaching theory with the practice, and facilitate the correction of the disjunction between theory and practice in the training of P.E. normal students under the COVID-19 epidemic. Of course, it is also possible to present the theory first, which certainly saves time compared with project-based learning, but it is not conducive to the combination of theory and practice for students to separate the theory from the source of practice.

As for the discussion and analysis of cases, it is often difficult to make a comprehensive analysis because of the quality limitation of the personal knowledge theory of offline teaching students, so the guidance of teachers and the team cooperation of students are particularly important. In order to cultivate the higher education theory accomplishment and characteristic teaching thought needed by the excellent P.E. teachers of normal students, the modern education teaching idea and the advanced teaching theory and method can be integrated into it when the teachers lead, which is beneficial to the formation of students' advanced teaching thought. During students' discussion, on the one hand, each student should be allowed express his own views and opinions by means of contribution evaluation, and importance should be attached to the setting and evaluation of student leaders; on the other hand, students' fear of making mistakes should be eliminated, students should be guided to actively participate and be encouraged to express their views boldly. In addition, teachers can also improve the theories that students lack by means of prompting, providing materials and theoretical guidance, so that they can master and construct knowledge while analyzing, and form their own solutions to problems.

The imitation, reconstruction and reconstruction of cases is a case improvement link after discussion and analysis, which is different from general case teaching. It is a process in which students improve, reconstruct and reappear cases to form their own PCK knowledge based on their own theoretical knowledge and experience and combined with the teaching situation of cases. In the imitation of cases, excellent teaching cases can be reconstructed by imitation, that is, students can repeat and imitate excellent practical cases to strengthen their understanding and memory of cases and accumulate rich teaching cases. In the reconstruction of cases, teachers can guide students to improve and optimize the problems presented in the cases by asking questions for cases that are wrong in the use of P.E. teaching theory, so that students can reconstruct the cases based on their own knowledge and experience, and reconstruct some links on the basis of the original cases to form new and correct cases. In this way, this process of case imitation and reconstruction can provide a path for the accumulation of rich teaching cases in PE-PCK excellent characteristics cultivation of normal students.

## **Solutions to Several Problems in the Application of Case Teaching Model for Normal Students in PE- PCK Excellent Characteristics Cultivation**

### ***Presentation of cases***

The case teaching model for normal students in PE-PCK excellent characteristics cultivation is a process of creating a case situation in which knowledge is applied to practice, so that students can use knowledge to analyze and solve practical problems in the study and analysis of case situations, and reflect, reconstruct and accumulate cases. Since the time of physical education classroom teaching is only 45 or 50 min, it is easy to get into trouble if students present physical education teaching cases without the accumulation of relevant knowledge, and their enthusiasm and initiative will be discouraged, which also makes it difficult to complete classroom teaching tasks within the specified time. Therefore, in view of students' poor knowledge accumulation, the study of relevant knowledge is the premise in case analysis. Before the implementation of case teaching, students need to have the cognition of relevant theoretical knowledge. In this way, when the teaching material analysis course is implemented in middle schools, students have already studied school physical education, middle school physical activities and curriculum teaching theory, and have already accumulated relevant knowledge, so cases can be presented after brief knowledge study and review.

### ***Handling of teacher-student relationship***

The case teaching model for normal students in PE-PCK excellent characteristics cultivation requires teachers to give full play to their leading role, to select, sort out and design cases, and to guide the theories embodied in the cases in the process of presentation and analysis, so as to bring students into the case scene, and to analyze and reflect on the cases with their own theories and experiences as teachers, students and class watchers. On this basis, they can reconstruct the cases, build their own knowledge of physical education and accumulate their own teaching cases in the whole process. The successful implementation of this process requires teachers and students to pay close attention to and interact with cases. Therefore, teachers should pay attention to the correct handling of the relationship between teachers and students in the whole process, and constantly change their roles, such as the role of guide and situational bringer before the case is presented, the role of teacher in the case analysis process, and the role of leader in the application of ideological theory to practice during case reconstruction, so that students can boldly imagine and be brave in innovation in the process of bringing, integrating and reconstructing scenarios.

### ***Processing of knowledge points in the teaching materials***

In the processing of teaching materials, it is advisable to sort out the main knowledge points and related knowledge points involved in the class before class because students' relevant professional knowledge is weak, so that the cases to be presented highlight the main knowledge points. Before the case is presented, the case should be introduced quickly according to the knowledge points, for example, in the review of relevant knowledge points. After the case is presented, it is appropriate to combine the students' analysis and present the analyzed knowledge points in the corresponding links of the case. When reconstructing a case, it is appropriate to reconstruct the case link on the premise of knowledge presentation. In this manner, the theory and practice are closely combined through the interlocking process, so that students can use theoretical knowledge to solve practical teaching problems in the whole process, and develop a scientific thinking habit of solving practical teaching problems.

### ***Treatment of teaching methods and organization***

In the implementation process of case teaching, students are required to analyze and reconstruct physical education cases according to their own relevant knowledge and experience and the situations presented by the cases. Due to the limitation of their own knowledge and experience, although students can raise some problems and solve them, it is difficult for them to fully grasp the case, summarize the theories and knowledge points reflected by the case, and reconstruct the case relatively perfectly. At this time, on the one hand, teachers are required to give timely advice, and on the other hand, AI education platforms can be used to provide materials,<sup>[12]</sup> but it also requires collaborative efforts among classmates. Discussions and cooperation among classmates can effectively shorten the time for problem-solving, harmonize student relationships, and enable students to speak freely in a relatively relaxed environment among classmates, unleashing the enthusiasm, initiative, and innovation of the majority of students.

### **Validation of Case Teaching Application**

On the one hand, the application of case teaching can be verified by interviewing and investigating students' acceptance status and existing problems in the setting, presentation, analysis and reconstruction of cases in case teaching, and investigating the improvement of students' acceptance and ability of case teaching; on the other hand, the effectiveness of this case teaching



method, which is repositioned under the guidance of excellence, on the cultivation of excellent P.E. teachers' knowledge of physical education can be verified by questionnaire survey and analysis.

A student survey on the case teaching model for normal students in PE-PCK excellent characteristics cultivation shows that the teaching process design of teaching theory learning-case analysis-case construction practice-reflective evaluation is 100% useful in PE-PCK construction (as shown in Table 3), which is in line with the learning sequence agreed by the middle school students interviewed. Thus, it can be inferred that such process design is expected by students and effective.

**Table 3. The role of case teaching process for normal students in PE-PCK excellent characteristics cultivation**

Role	Subtotal	Proportion
Very useful	36	66%
Relatively useful	11	20%
Useful	8	14%
Not very useful	0	0%
Not useful	0	0%
Total	55	100%

Moreover, in order to verify the effectiveness of the case teaching model for normal students in PE-PCK excellent characteristics cultivation to construct the content and characteristics of PE-PCK of excellent teachers, a special investigation was made on the promotion effect of this model on the subject teaching knowledge. Students think that this model can improve the differential treatment, promote the development ability of each student, improve the educational theory literacy, enhance the subject teaching theory knowledge and accumulate rich teaching cases. Obviously, this model can promote the construction of PE-PCK excellent characteristics content and characteristics for P.E. normal students (Table 4).

**Table 4. The role of case teaching in promoting the following PCK**

Contents	Subtotal	Proportion
A. Improving educational theory literacy	9	16%
B. Improving the theoretical knowledge of P.E. teaching	9	16%
C. Helping to accumulate rich teaching cases	8	14%
D. Helping to summarize the teaching experience	6	10%
E. Helping to form the characteristic teaching thought	4	8%
F. Helping to improve the ability of teaching strategy selection and application	3	6%
G. Helping to improve the teaching design ability	3	6%
H. Enhancing the ability to discriminate and promote the development of each student	13	24%
I. Other aspects	0	0%

## CONCLUSION

Research shows:the case teaching model for normal students in PE-PCK excellent characteristics cultivation conforms to the learning characteristics of normal students, can meet the needs of PE-PCK excellent characteristics cultivation of normal students, is beneficial to changing the weak subject and teaching knowledge status of normal students, solves the problems of insufficient practical teaching, separation of theory and practice, lack of practical teaching experience, and insufficient accumulation of excellent physical education teaching cases, etc. in the cultivation of normal students, cultivates excellent P.E. teachers' characteristic teaching ideas, case accumulation, teaching theoretical knowledge, etc. of subject teaching knowledge,

and can also improve students' abilities of reflection, teaching practice, problem analysis, problem solving, and creative teaching, etc.

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