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Research on PCK Theory Based on Core Literacy -- A Case Study of High School Physics Teaching

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Abstract: ***The core quality of physics in senior high school aims to train students to understand nature from the perspective of physics, understand nature, learn to explore, experience scientific research methods and develop scientific thinking habits. Teachers should have certain means in the leading process. Therefore, under the premise of taking the core literacy of physics as the guidance, this paper, through the content of the basic core literacy of physics, once again studies the teacher's PCK theory of Schulmantift, analyzes the content of the PCK theory and its specific guiding role in teaching, summarizes the basic methods to achieve the core literacy of physics, and summarizes the construction process of the teacher's PCK theory.***

Keywords: Core quality of physics discipline; High school physics; PCK theory.

1. INTRODUCTION

High school is the re-education and advancement of students after the completion of nine-year compulsory education. In high school learning, students gradually form their own values. The core quality of discipline is the embodiment of the values of discipline education, and is the process of students forming their own correct values and abilities through discipline learning. The core literacy of physics discipline mainly includes four aspects, namely "physics concept", "scientific thinking", "scientific inquiry" and "scientific attitude and responsibility". The core quality of physics can be regarded as some basic physical qualities that students need to acquire through high school physics learning. In order to make students form such physical quality and have such physical core quality, the key is reflected in the teaching process of teachers. There is a Chinese saying that "to give students a bowl of water, teachers must have a bucket of water first." But if teachers have a bucket of water for a long time, can they really give students a bowl of water? I'm afraid not. We need to consider how to give this cup of water in what form, and what kind of state we can give them.

As early as the 19th century, Schulman of the United States put forward the PCK theory in response to the requirements of the teacher assessment system at that time. He proposed PCK theory includes "using the integration of professional subject knowledge and pedagogical knowledge to understand how the teaching of a specific unit is organized and presented to adapt to the different interests and abilities of different students". In the later development, Grossman defines PCK as four parts: "Knowledge about the teaching purpose of the subject, students' understanding and misunderstanding of a certain knowledge, curriculum and textbook knowledge, teaching side ratio and presentation knowledge of specific topics [1].

Characteristics of PCK theory: PCK theory is related to subject content. Teacher's PCK theory is the knowledge that teachers process, transform, express and impart their subject knowledge to students in a way that is easy for students to understand. Before imparting knowledge, it is necessary to consider the form of imparting such subject knowledge, processing method and transformation effect; The PCK theory is based on the reflection of experience, which is connected with the practice of teachers and reflects the negative thought of philosophy. It is a gradual rising process of reflection, re-summarization, re-practice, re-reflection and re-summarization in the teaching practice of teachers; PCK theory is personalized. In the teaching process, facing different students, due to their different pre-knowledge ability, understanding ability and thinking ability, teachers should also have different ways in the teaching process to receive better results; PCK theory is objective. In the process of imparting knowledge, students' learning environments and cognitive abilities are different, so the corresponding forms of imparting knowledge should also be different; Overall, it reflects its comprehensiveness, that is, it is connected with and integrated with various factors, and teachers can form a stable teacher PCK structure only by adopting varied teaching methods. Combined with the core accomplishment of physics in senior high school, this paper expounds the position of PCK theory in teaching from the following aspects.

2. PHYSICAL CONCEPT

The physical concept is the basic understanding of matter, movement, interaction and energy formed from the perspective of physics. It is not a physical concept, but is formed after refining and sublimating the physical concepts and laws in the mind through high school physics learning. In the process of building physical concepts, PCK theory should be used to reflect the step-by-step approach in physics teaching. First, some physical concepts should be explained and analyzed, then promoted to understanding and application in life, and then gradually strengthened, sublimated to students' physical concepts. For example, in the teaching of the concept of energy conservation, the teacher first expounds the law of energy conservation in mechanics, obtains the facts of the law of conservation through experiments, and then extends to electricity, heat, optics, atomic physics, etc. If we can always hold on to conservation in the process of energy research in the teaching process, students will gradually

internalize the concept of energy conservation from the original law of energy conservation.

3. SCIENTIFIC THINKING

"Scientific thinking is a way of understanding the essential attributes, internal laws and interrelationships of objective things from the perspective of physics; it is an abstract generalization process of building physical models based on empirical facts; it is the specific application of methods such as analysis, comprehensive reasoning and demonstration in the scientific field; it is the ability and character of scientific reasoning based on factual evidence to challenge and criticize different views and conclusions, test and revise them, and then put forward creative ideas" [2]. This coincides with the requirements of PCK theory that teachers should teach students to understand a certain topic and misunderstand the form of knowledge transfer. In the process of knowledge transfer, teachers should reflect the content of knowledge and be able to understand and apply it. At the same time, teachers can intentionally introduce students into the wrong areas in the process of teaching. Through the questioning of some top students, most students will reflect and explore again, and then reflect on the wrong areas of understanding again with the joint research of teachers. So in the teaching process, such affirmation, questioning, reflection, negation and reconstruction of the teaching form [3], on the one hand, reflects the leading role of teachers in the teaching process, on the other hand, reflects the main role of students in the teaching process, and achieves the goal of gradually improving students' thinking ability and scientific judgment thinking mode.

The formation of scientific thinking, in the process of teacher teaching, is not simply the accumulation of subject knowledge, but the presentation of knowledge to students through the construction process of questioning and criticizing opinions and conclusions. What is required is the way and skills of teachers in the process of knowledge presentation, which is the requirements of teachers in the "teaching form of understanding and misunderstood knowledge to students on a certain topic" of teacher PCK theory. Through this form, students can gradually internalize scientific research methods into their own set of physical scientific thinking. Physical scientific thinking mainly includes model construction, scientific reasoning, scientific argumentation, questioning and innovation, etc. According to the objectivity and comprehensiveness of teachers' PCK theory, teachers should constantly adjust their teaching forms for the formation of different scientific thinking forms.

4. SCIENTIFIC INQUIRY

Scientific inquiry refers to the ability to raise physical questions based on observation and experiment, form conjectures and assumptions, design experimental schemes, obtain and process experimental information, draw conclusions and explain based on evidence, and communicate, evaluate and reflect on the process and results of scientific inquiry. Physics is a science that should be based on experiments. Experimental ability is the basic ability that students should master, but scientific inquiry focuses on the process of inquiry rather than simple experiments. The individualization of teacher's PCK theory shows the process of constantly summarizing and innovating knowledge within the specific scope of their own class in the teaching process [4]. Teachers need to combine the requirements of the core quality of physics with their own understanding, generalization and systematization to gradually achieve teaching objectives through interaction with educational practice.

For example, in the training process of scientific inquiry, taking Galileo's Ideal Oblique Experiment as an example, the initial contact is in the process of exploring the free falling motion. First, Aristotle believed that the heavy object fell faster than the light object, then Galileo questioned and raised questions, then the experimental verification proved that two iron balls fell at the same time, and then the simple slope experiment verification was used to carry out reasonable extrapolation, and finally it was proved that the nature of the free falling motion was a uniformly accelerated linear motion with zero initial velocity [5]. This process shows that the conclusion of science needs to be verified by experiments, and the premise of inquiry is to put forward assumptions and questions. In combination with the teaching situation, the teacher should guide students to think about the method and verification scheme of the law before each physical experiment law is drawn. After the scheme is drawn, the teacher should also encourage students to go to the laboratory to verify their conjectures and process data reasonably. When the data is different from their conjectures, the teacher should guide students to analyze and explain [6]. Then students will gradually form their own scientific research ability in the process of such questioning and inquiry.

5. SCIENTIFIC ATTITUDE AND RESPONSIBILITY

Scientific attitude and responsibility are the internal power of exploring nature gradually formed on the basis of understanding the nature of science and the relationship between science, technology, society and environment. They have curiosity and thirst for knowledge in scientific research, and can take the initiative to study. They always adhere to scientific and rigorous attitude, respect facts and respect others in the process of exploration. The opinions or experimental conclusions are based on experiments. They do not tamper with data, do not cater to the attitude of not superstitious authority, and are responsible for their own opinions.

It seems that the saying "to give students a bowl of water, you have to have a bucket of water" is certainly good. However, this "bucket of water" does not mean a simple amount of knowledge, but requires teachers to have both quantity and quality, and higher requirements for quality. This requires teachers to constantly improve themselves and pay attention to the analysis and

adaptation of teaching knowledge and students' quality. PCK theory is a hint and guidance to educators. Its theory points out that educators should have knowledge of teaching, learners' knowledge, teaching situation knowledge and teaching method knowledge. Although this theory is constantly changing and developing, scholars have a unified understanding of the essence of PCK theory; It is necessary to explain the learned knowledge in an effective way to guide students to understand new knowledge; Is the knowledge associated with specific knowledge; It is knowledge about a certain topic, and it is a process of continuous improvement and construction.

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