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On the Cultivation Strategy of Scientific Thinking in the Core Accomplishment of Physics of Senior High School Students

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Abstract: The new curriculum reform requires that physics teaching should pay attention to cultivating students' ability to think independently, highlighting the thought method, teachers guide students to take the initiative to solve problems independently, and cultivate students' physical core accomplishment. Based on the curriculum standards and the author's investigation and research on the basic situation of physics core literacy of high school students, combined with the connotation of physics core literacy, this paper mainly discusses the cultivation strategy of physics core literacy from four dimensions of "physics concept", "scientific thinking", "scientific inquiry" and "scientific attitude and responsibility".

Keywords: Physics; Core literacy; Strategy

China started the curriculum reform of ordinary senior high schools in 2000. Over the past 20 years, the reform process has been from the 18th National Congress of the Communist Party of China (CPC)[1]to the 2021 National Education Conference, where General Secretary Xi Jinping made an important speech, emphasizing "cultivating socialist builders and successors with all-round development in morality, intelligence, physique, beauty and labor [2]". In recent years, the core accomplishment based on quality education has become a hot topic in the educational circle. The development of core literacy aims to cultivate all-round people who meet the needs of personal development and society. The implementation of core literacy depends on subject teaching, and various disciplines set off a research upsurge on the subject core literacy.

Core literacy of physics is derived from scientific literacy, and is also the embodiment of core literacy in physics, and can be understood as the necessary character and key ability gradually formed by students in the process of receiving physics education to meet the needs of lifelong development and social development. These basic qualities and abilities have the characteristics of physics, and the basic requirements can be roughly divided into three aspects: understanding basic knowledge of physics, mastering basic skills and research methods of physics, and establishing the connection between personal physical literacy and social development.

The "Physics Curriculum Standards for Ordinary Senior High Schools" issued by the Ministry of Education at the end of 2017 emphasizes that subject core literacy is the concentrated embodiment of the value of subject education in education, and is the correct value concept, essential character and key ability formed by students in subject learning. The core literacy of Physics discipline in China is defined from four dimensions of "physical concept", "scientific thinking", "scientific inquiry", and "scientific attitude and responsibility" [3].

1. The cultivation strategy of physical concept

1.1 Integrate into the history of physics and perceive the formation process of physical knowledge

Covers all physics history in the formation of physical knowledge, through to the physical concepts and laws of tracing and perception in the formation of physical knowledge, students can really understand its connotation, more enlightenment beyond knowledge itself, sets up the profound physical concepts, such as material, movement and interaction, energy, etc.

For example, in the formation process of the law of free fall, Aristotle believed that heavy objects fall to the ground before light objects. Due to the authority of Aristotle at that time and the limitations of history, this conclusion was generally accepted to be correct. Later, Galileo had the courage to question, and through wonderful logical analysis, overturned the wrong conclusion that had long affected people's cognitive movement, which was an ideological revolution freed from the mental shackles of Aristotle. Through the perception of this process, students realize that "objects move for a reason", mass is not the factor that affects the speed of objects falling, and promote students to form a correct view of motion.

1.2 Experience the exploration process and establish the correct physical concept

The formation of physical concepts is not accomplished overnight. The "indoctrination" education, which emphasizes the result rather than the process, can make students remember the conclusion, but it is not conducive to students' internalization and application of physical concepts and laws. The teaching of concepts and laws should not be completely replaced by teachers themselves, or even simply "bring out" conclusions. Students should "remember" that they should pay attention to the process of inquiry, carefully organize scientific inquiry activities, and let students internalize physical knowledge in the process of inquiry and sublimate it into

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physical concepts.

For example, in the teaching of the concept of "resistance", the concept of "resistance" should be explored through experiments. On the basis of students' experimental operation and obtaining experimental data, the teacher should guide students to conduct experiments, and then carry out analysis, discussion and communication. On the basis of obtaining a large number of experimental data, the conclusion can be drawn: For a conductor, the ratio of the voltage applied to both ends of the conductor to the strength of the current flowing through it is a constant. This constant has nothing to do with the specific value of voltage and current intensity, but only depends on the conductor itself and reflects the blocking effect of the conductor on the current. Students are more convinced and impressed by the conclusions they draw from the process of scientific inquiry, thus strengthening the learning of physical concepts and laws and promoting the formation of physical concepts.

1.3 Apply theory to practice and strengthen physical concepts

The physics knowledge learned by senior high school students is a high summary and abstract generalization of the previous research conclusions. These theoretical knowledge are obtained from the objective laws of things in constant practice under certain historical conditions and used to solve practical problems. Most of the theories that students learn in the classroom are indirect experiences that must be linked to practice before they can be tested and developed. Therefore, in teaching, teachers must cultivate students' practical consciousness, and as far as possible to provide practical conditions, in practice exercise students from the perspective of physics to explain natural phenomena and solve practical problems, physical concepts and laws continue to refine and sublimate, physical concepts can be strengthened.

In motor learning, for example, based on the working principle of the ampere force related knowledge and motor learning, to conduct a lesson practice "to improve the speed of the toy car", students apart the toy car motor, by increasing the number of turns of coil, and replace the stronger magnets, magnetic using power output bigger battery at the same time, make the speed of the car gets great improvement. In this process, students use the physics knowledge they have learned to solve practical problems, have a deeper understanding of the theoretical knowledge they have learned, form and strengthen the concept of physics, and promote the formation of the core quality of physics.

2. The cultivation strategy of scientific thinking

2.1 Establish an abstract model to guide students to think

Model construction is an important part of scientific thinking. Turning complex physical situations into simple physical models makes it easier to find and solve problems. In daily teaching, teachers should guide students to think and extract important factors and essential characteristics in practical problems, simplify the complex state of the research object in the research process, so as to get a relatively simple physical model, so that students can develop scientific thinking while mastering knowledge.

For example, in the study of mechanical motion, when the influence of the linearity of the object on the studied problem can be ignored without timing, the object can be simplified as a point with mass. The establishment of the model of "particle" facilitates students' learning of the follow-up knowledge of kinematics.

In the study of electric field and magnetic field, it is very difficult to study and describe such material because "field" is "invisible and intangible". The establishment of electric field line and magnetic induction line models turns abstraction into concreteness, making it easier for students to realize the objective existence of "field" and understand the importance of constructing models.

2.2 Select interesting materials to arouse active thinking

Interest is the best teacher. The materials chosen in teaching should be of interest to the students and should not be boring. Interesting class can attract students' attention, stimulate the subjective initiative of thinking, so that students complete the role change from "the one who knows" to "the one who is good" to "the one who is happy", students' thinking alive, the classroom also alive.

For example, in a circular motion analysis, select one of the instances of "water shooting star", spectacular acrobatic video and magical phenomenon attracted students from the start, with the curiosity and thirst for knowledge into the classroom, teachers to seize the favorable opportunity, guides the student to review the knowledge of circular motion, and to explain water meteor phenomenon. In the active classroom atmosphere, students actively think and explore, and their thinking ability is highly efficient.

2.3 Carefully design questions to train students' quick thinking

The motivation of promoting the development of students' thinking includes motivation, desire, interest and hobby, among which interest is the most lively factor to stimulate students' thinking, while questioning is the "catalyst" to stimulate interest. Concise questioning is to set up a magnetic field for students, with teachers as conductors, to stimulate students' interest, curiosity and thirst for knowledge, and make them surge up the impulse to learn, so as to activate and activate their thinking [4]. Well-designed questions can promote communication between teachers and students, accord with the principle of inspiration, improve classroom efficiency, and cultivate students' quick thinking. Design problems make it necessary to avoid mechanization, randomization,

For example, in the section of "case analysis of circumferential motion", it is difficult to analyze the conical pendulum when students first contact with the centripetal force provided by two forces that are not on a straight line. The teacher can inspire students to think actively and gradually master the characteristics of the conical pendulum through progressive problem series.

3. Cultivation strategies of scientific inquiry

Scientific inquiry focuses on the process, so teachers should carefully preset the process of inquiry. Students are the main body of the process. In the process, teachers should guide students to explore and raise questions from the physical situation provided. Conjecture and hypothesis based on existing knowledge; Control variables, equivalent substitution method and other research methods are used to design experiments and make plans, conduct experiments, analyze experimental phenomena and experimental data, draw conclusions, inference and transfer of conclusions.

3.1 Connect with real life to stimulate interest in exploration

When designing inquiry activities, students should explore the materials in real life, so that they can appreciate how physical knowledge is connected with the real world. Starting from the things or problems that students are interested in and familiar with, it is easier to stimulate students' internal learning motivation and desire to explore.

For example, to explore "the conical pendulum," select students interested in amusement park rotary swing as analysis object, and guide students to explore "passengers for swinging Angle and what factors", student experience first guess, coupled with circular motion after the related theoretical analysis it is concluded that the conical pendulum swinging Angle associated with the speed of cycloid length, circular motion, has nothing to do with the quality.

3.2 Create inquiry situation and create inquiry atmosphere

When teaching, the creation of appropriate situations, so that students are in the classroom but as if they were there, create an atmosphere of inquiry, which is conducive to stimulate students' interest in inquiry and real emotion, mobilize students' thinking, so that the classroom really "live" up. Students acquire knowledge and develop their scientific inquiry ability in positive emotions and optimized situations.

For example, when teaching the concept of "overweight and weightlessness", introduce students to such a situation: imagine that they take an elevator from the first floor to the eighth floor, and how their weight changes when the elevator starts and stops? It is easy for students to get into the situation and say what they feel, thus gaining a deeper understanding of "overweight and weightlessness".

3.3 Pay attention to students' practice and strengthen their ability of inquiry

In the investigation of the development status of physics core literacy of senior high school students, it is found that most students are familiar with the experimental principle of inquiry experiment, but poor in the design of experimental steps. The current high school physics experiment teaching, many teachers for saving time, afraid of trouble, you don't succeed, just don't do experiments, or replace with video demonstration, this kind of teaching method of "genuine", kill the essence of the scientific and practical, students can only machinery, superficial "remember" the experiment principle and experiment conclusion, poor teaching effect naturally. Learning physics must do more experiments, schools, teachers should create more experimental conditions, avoid concept preaching, let students as much as possible to obtain direct experience, avoid too much indirect experience.

4. The cultivation strategy of scientific attitude and responsibility

4.1 Teachers "set an example"

It is very important for teachers to teach by word of mouth and by example to cultivate students' scientific attitude and sense of responsibility. Teachers should be scientific and rigorous in new lesson teaching, and all contents must be true and accurate physical knowledge; Follow logic and caution in drawing conclusions; When explaining the problem, the process should be correct, logical and accurate; In the answer to students' questions, can not be perfunctory or answer their not sure of the answer, if you can not answer at that time, after the event must also give students an answer; When doing demonstration experiments, operation steps and error analysis should be practical and realistic, not perfunctory. Teachers must set an example for students, so that students can maintain a correct attitude and sense of responsibility in physics study and even in life [5].

4.2 Attach importance to education on the relationship between science, technology, society and environment, and improve the sense of responsibility

In the teaching process, we should establish the connection between scientific and technological progress, social development and environmental protection, train students' sense of responsibility, infiltrate humanistic history and patriotic education, set up realistic attitude and scientific spirit, and train scientific attitude and responsibility in various directions.

5. Conclusion

At present, the focus of China's education reform is to "face all students, promote the all-round development of students, focus on improving students' sense of social responsibility to serve the country and the people, innovative spirit of exploration and practical ability to be good at solving problems". The core accomplishment is the perfection of scientific accomplishment in educating people. Student development core literacy is in the upper position, which points to the overall development of students, while subject core literacy is in the lower position, which also points to the overall development of students.

In high school physics teaching, we should change the traditional teaching concept, use innovative teaching methods, cultivate students' interest in learning, improve students' comprehensive quality and ability, stimulate students' physical thinking, and lay a solid foundation for deeper learning and application in the future. The study of "physical discipline core literacy" can provide a reference for physics teaching activity design, implementation, be helpful for students to learn physics clearly target workers evaluation index of learning and teaching, promote the education workers reflections on the present situation of teaching, and to constantly find and solve problems, improve the basic education work.

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