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Ideological and Political Design in High School Physics Curriculum

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Abstract：The scientific world outlook, epistemology and methodology embodied in physics are an important foundation for the development of human society, which profoundly affects people's way of thinking and basic understanding of the objective world. The high school stage is a stage when a person is about to mature, and it is also a stage when a person's worldview and values are about to be gradually established. In this sense, high school physics has the incomparable importance of other basic courses in high school. The article takes scientific spirit, scientific ability, scientific aesthetics, scientific literacy, and scientific attitude as the starting point of the ideological and political design of the high school physics curriculum, and takes the guide expansion, question answering, and physics experiments as the starting point of the curriculum ideological and political design, and discusses the thinking of the high school physics curriculum.

Keywords：High School Physics; Curriculum Ideology and Politics; Design; Starting Point; Key

1. Introduction

Physics is a natural science that studies the basic structure, motion form, interaction and transformation laws of matter. The scientific world outlook, epistemology and methodology embodied in physics are an important cornerstone of the development of human society, and have a profound impact on people's way of thinking and the basic understanding of the objective world. As a basic subject, high school physics curriculum not only focuses on cultivating students to form a scientific outlook on material and a correct world outlook, but also enables students to form correct values.

General Secretary Xi Jinping pointed out at the National Education Conference on September 10, 2018. That it is necessary to integrate morality and education into all aspects of ideological and moral education, cultural knowledge education, and social practice education. General Secretary Xi's instructions have provided important inspiration for the implementation of ideology and politics in various fields including high school basic education: ideological and political courses should be integrated into daily learning, and traditional ideological and political courses should be expanded into "course ideological and political courses". At the high school stage, the physics curriculum that best reflects the scientific spirit, scientific attitude, scientific thinking and scientific charm should assume the main ideological and political responsibility for the curriculum.

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2. The starting point of high school physics ideological and political design

High school physics plays an important role as a theoretical bridge from abstract mathematical logic to objective reality. It is an enlightenment for high school students to recognize and understand the development law of the objective world, and to find the right course ideas for the next step of learning university mathematics and physics knowledge and even engaging in scientific research activities. The starting point of politics will have a multiplier effect.

2.1 Ideological and political establishment of scientific spirit

The history of physics can be inspiring. Taking Newton as an example, he proposed Newton's three laws of motion which laid the foundation of classical mechanics; however, when Newton discovered the law of universal gravitation, he also paid unimaginable energy. He used to immerse himself in research in the laboratory without sleep or sleep, but what he tried at the beginning were some unrealistic theoretical derivations. In the end, he successfully discovered the law of universal gravitation and its formula, proving himself and making all the previous efforts pay off. The falling of the apple gave Newton inspiration. If you change to a mortal, you may only get a pain in the flesh. The road to scientific research is not destined to be smooth sailing, and life is also the same. This firm will to advance bravely and indomitably is the scientific spirit that guides scientific researchers to success.

By integrating ideological and political education into the high school physics curriculum, teachers can let students appreciate the difficulties in the development of physics, as well as the scientific spirit of scientists who are constantly challenging the pinnacle of physics. This kind of spirit will induce students to look down on the pressure of the college entrance examination, and correctly influence a student's way of thinking about various problems in the future. Its formation is often more important than learning a problem solution and mastering a formula. It is also the next high school physics education system. A new direction to strive for.

2.2 Ideological and political cultivation of scientific ability

In "Teacher's Talk", Han Yu described the function of the educator as follows: "Teacher, so preaching, teaching, and demystifying is also." After solving the academic difficulties, students will encounter endless new difficulties in reality in the future.

Which reflects the importance of cultivating students' scientific ability. The so-called "education" is to let students develop a serious scientific attitude and strong scientific ability, and let students dare to face difficulties like pioneers in various fields of physics in history when they are separated from textbooks in the future, and actively use science.

The key to cultivating scientific ability is to guide students to think independently, rather than to follow the script, and it is suitable to add ideological and political elements in the guidance. The teacher can demonstrate to the students the free fall motion of the stone and the feather in the form of a classroom experiment: the stone and the feather are raised to the same height from the ground, and they are released at the same time. The feathers fell slowly, and their trajectories were erratic. At this time, the teacher explained the experimental results. The rapid and straight fall of the stone is due to the action of gravity, while the feathers are subject to relatively large air resistance in addition to gravity, and are realized as slow falling. Through such an answer, the teacher can lead to the explanation of the particle point: not all research objects can be regarded as particle points, only those research objects whose size and shape have no or negligible influence on the movement process can be regarded as to be a mass point, that is, to treat the research object as a point with its own mass but without any volume, such a conditional approximation is to simplify the thinking and operation in the research process. After such a vivid explanation, students can more intuitively understand the description of the particle and the meaning of its existence.

Similarly, when studying electromagnetism in high school physics courses, teachers can use the examples given when teaching mechanics to lead to topics, and let students associate the simplification of research objects in electricity: electrons moving in an electric field can also be approximated as a point with only charge and no volume, and when studying the charge distribution of the iron ball in the electric field, the shape of the iron ball also affects the distribution of the charge. For electrons, the iron ball is

macroscopic, so the iron ball cannot simply be regarded as a point charge to treat. Such ideological and political design can guide students to stimulate the ability to draw inferences from other facts and associative awareness, and cultivate students' scientific ability and literacy.

2.3 Ideology and politics cultivate scientific aesthetics

Physics is beautiful, and its beauty lies in symmetry and unity. For students in high school, they have not yet fully understood the physics system, and teachers need timely and appropriate guidance to help them develop the insight into discovering the beauty of science and their love for science at this stage, and then shape students' pursuits. The aesthetics of truth, goodness and beauty affect their moral values and personal qualities.

Regarding symmetry, the most typical example is Maxwell's equations. Among them, Gauss's law describes the electric field in the presence of a dielectric. Gauss's law of magnetism describes the existence of a magnetic field, and the two are symmetrical to each other; the magnetoelectric effect is described by Faraday's law of electromagnetic induction, and the electromagnetism effect is described by Maxwell-Ampere's law description, the two are symmetrical to each other. The entire classical electromagnetism became symmetrical and unified due to Maxwell's efforts, and he also predicted the existence of electromagnetic waves and the characteristics of light as an electromagnetic wave, which were confirmed shortly thereafter. The same symmetry is also reflected in the relationship between gravitational and electromagnetic forces.

The law of universal gravitation and Coulomb's law respectively describe the universal gravitation between matter and the Coulomb force between charges. Although they belong to different subfields, their description forms and formulas can be said to be completely consistent. At the same time, the means of confirmation of the two, the Cavendish torsion balance and the Coulomb torsion balance, are very similar. These two fully demonstrate the symmetry between the field of mechanics and the field of electromagnetism, and even the discovery of the gravitational field in recent years has confirmed the hypothesis put forward by Einstein, which is also another mapping of electromagnetism in the field of mechanics.

The unity of physics is also reflected in the high school physics stage. The transformation of kinetic energy and gravitational potential energy reveals that one kind of energy can be transformed into another kind of energy; And the elicitation of elastic potential energy shows the diversity of the existence of energy, that is, potential energy has more than one form of existence. Similarly, the mutual conversion of electrical energy and magnetic energy also characterizes the conversion and conservation of energy that also exists in the field of electromagnetism; In the field of thermodynamics, the first law of thermodynamics describes the transfer law of heat energy; At the same time, some inventions also show the unity of physics, such as the induction cooker converts electrical energy into heat energy, and the internal combustion engine converts internal energy into kinetic energy. These contents ultimately provide a theoretical basis for the law of conservation of energy.

In the field of optics, at first, the particle theory of light proposed by Newton was widely adopted by the world. Later, the results of the double-slit interference experiment verified the wave theory of light. However, the demonstration of Planck's law of black-body radiation and Einstein's analysis of the photoelectric effect made people re-acknowledge the particle nature of light. Finally, physicists revealed the wave-particle duality of light by using the energy-level transition mechanism, that is, light has both wave and particle properties at the same time. The emergence of quantum mechanics broke the barriers of classical physics, and explained some physical phenomena that could not be explained by the previous physical system in a broader context. De Broglie went a step further. He proposed the concept of matter waves and predicted that all microscopic particles have wave-particle duality. With more and more particle wave experiments, this theory is being confirmed in various ways.

If these cases are integrated into high school physics teaching activities, it will greatly increase students' interest in physics, make them good at re-examining book knowledge from an aesthetic perspective, discover points they have never thought about, and attract students to immerse learning and exploratory learning. Learning, so that students fall in love with learning and be good at

learning.

2.4 Ideological and political improvement of scientific literacy

Although high school physics teaching has obvious test-oriented features, it must not degenerate physics teaching into test-oriented education, and ignore the improvement of students' scientific literacy. Therefore, improving scientific literacy should be one of the tasks of classroom ideological and political design. The State Council made it clear in the "Decision on Deepening Education Reform and Comprehensively Promoting Quality Education" "The implementation of quality education should run through early childhood education, primary and secondary education, vocational education, adult education, higher education and other levels of education; School education, family education and social education." This is a clear definition of the implementation of quality education, including high school education. "China Education Reform and Development Outline" clearly pointed out that cultural and scientific quality education is one of the contents of "quality education", and also includes ideological and moral quality education, labor skills quality education and physical and psychological quality education.

In addition to the fusion of Hegel's dialectics and Feuerbach's materialism, the three major scientific discoveries in the nineteenth century the law of conservation of energy, the cell theory and Darwin's theory of biological evolution, also provided a natural scientific basis for the emergence of Marxism. Although these three belong to the field of science, each is full of ideological and political elements. Their existence explains the unity and materiality of the world, and also contributes to the great development and progress of philosophy. Einstein adhered to the materialistic concept of science, believing in the unity of the material world. He found that the transformation of Maxwell's equations in classical physics under Newton's classical mechanics system is asymmetric. Based on dialectical analysis, he realized that the definitions of absolute time and absolute space cannot be self-consistent in some scenarios, so there is a complex relationship between time and space that can be self-consistent. After some research, Einstein proposed the special theory of relativity, using the Lorentz transformation to replace the Galileo transformation in classical physics, bringing physics to a new stage. Later, he found that the symmetry under the transformation of inertial frame and non-inertial frame has not been solved. After a long independent analysis, he once again denied the existing physical theory system and proposed the general theory of relativity.

The above examples demonstrate the close connection between science and philosophy, which can help students improve their scientific literacy in the process of learning knowledge. Science has no end, and human beings are always on the road of exploring the truth; As long as physics is still imperfect, ideological and political theories will continue to guide the pace of human knowledge.

2.5 Correct and scientific attitude towards ideology and politics

The high school stage is the accumulation process of students before taking the college entrance examination. Incorporating ideological and political elements into the course of physics teaching can make students correct their scientific attitude, not only pass the college entrance examination well, but also make a good life for students, so that students will not be left due to attitude problems in their future scientific research and struggle.

The scholar Halley (discoverer of Halley's Comet) was also one of the few good partners in Newton's life. One day, when Halley visited Newton, the two discussed astronomy together. In the meantime, Newton will invite Halley to see his manuscript demonstrating the law of universal gravitation. Halley was shocked by Newton's great discovery after seeing the manuscript, and hurriedly persuaded Newton to publish his result as soon as possible; but Newton did not adopt this suggestion, and did not publish the result in his own work until after many scrutiny and examination. In "Mathematical Principles of Natural Philosophy". When sorting out Einstein's notes, staff at the Planck Institute for History in Germany found that Einstein had put forward the general theory of relativity three years before he published it, but he did not publish it out of a scientific attitude of careful verification. a theory. It was not until a later experiment on Mercury's orbital irregularities and solar eclipses that he finally believed in the correctness of his theory and published it.

The bright stars in the long river of physical development have been tempered by thousands of people, and they are obtained by countless scientists who have given their youth and even their lives. All the glorious stories are the result of their meticulous, industrious scientific attitude. Therefore, it is necessary for students to learn this scientific attitude of bold assumptions and careful verification in the ideological and political experience, and bring this attitude to study, life and future work, so that students can take their own responsibilities.

3. The foothold of high school physics ideological and political design

Ideological and political design is to combine the lessons to be taught with the ideological and political content in each process of the teacher to make the classroom more lively and active, and at the same time play the role of learning professional knowledge and spreading the positive energy of ideological education. To add ideological and political elements to high school physics, it is necessary to guide students to establish a necessary, accurate and relatively complete physical theoretical system, and at the same time help students to establish correct values, scientific literacy, enthusiasm for knowledge and innovative spirit. The foothold of introducing ideological and political design into high school physics courses mainly includes the following aspects.

3.1 Ideology and politics in the development of tutoring

Putting more effort in the tutorial link can improve the classroom atmosphere and achieve multiplier effect with half the effort. It not only explains the themes and main content of the following chapters, but also allows students to warm up the following learning, and positive results are generated during the tutorial process. A good tutorial link should be one that reasonably arranges ideological and political content. By introducing specific scenes in life, common sayings and famous sayings, and famous stories in history, students can feel the knowledge of books and the knowledge of books in the tutorial. The close connection between actual production and life, realize the practical significance of physics for people to transform objective things, and realize the importance of learning high school physics well.

For example, when talking about the chapters of the first cosmic speed and the second cosmic speed, the teacher can first conduct a tutorial session that includes ideological and political design. Teachers can use multimedia equipment to play videos prepared in advance about the development of China's aviation in the classroom, starting from the first artificial satellite-Dongfanghong-1 ascending into space, to the US-Soviet space hegemony, the Americans landing on the moon. When Tiangong-2 takes off, the Chinese will soon have their own space station. This great journey has demonstrated the courage and belief of the Chinese people to explore the unknown, and demonstrated China's powerful capabilities and wisdom. Adding such a display in the tutorial session can stimulate students' national self-confidence and yearning for physics, so that students can actively participate in the follow-up learning; At the same time, it can better connect the content to be taught, and truly bring book knowledge to the fore. combined with real life. When students see the scene of the rocket taking off, they can truly feel the existence of the first cosmic speed, so they can actively think about its meaning and connotation.

3.2 Ideology and politics in answering questions

In the question-and-answer session of the daily exercises, the teacher not only provides the problem-solving process and ideas, but also uses ideological and political design to guide students to think at a deeper level, so as to truly draw inferences from one case and integrate them. Many of the exercises are similar to application problems and are based on actual scenarios in daily life. For this kind of topic, teachers should properly guide students to use common sense in life to think, so as to get rid of the fixed thinking in books, cultivate students' flexible problem-solving ability, and achieve "from life to life".

An existing multiple-choice question is as follows: Considering increasing the maximum speed limit of a ring-shaped expressway, what improvements can be made to the expressway?

A. Increase the radius of the bend

B. Reduce the slope of the curve

C. Increase the radius of bridges along the route

D. Reduce the radius of the connection between the slope and the road

This problem examines the uniform circular motion of a vehicle. When the vehicle travels on the expressway around the city at the maximum speed limit, it can be approximated as the vehicle doing a uniform circular motion. At this time, the resultant force of gravity, supporting force and frictional force provides the centripetal force for the vehicle. According to Newton's second law, the expression of the external force and acceleration of the vehicle at this time can be listed: $m \cdot g \cdot \tan\theta = m \cdot v^2/R$. According to the formula, the answer to this question can be obtained. If you want to increase the maximum speed limit v of the highway, you can solve it by increasing the radius of the curve and the radius of the bridge. The answer to this question is to choose A and C. The problem is that some students are hesitant in the face of multiple-choice questions, and consider why they do not choose D. The speed of the D term increases, and the radius of curvature decreases. According to Newton's second law, $F_N - m \cdot g = m \cdot v^2/R$, it seems feasible to increase the support force. However, the students raised this question precisely because they only looked at the problem from the perspective of formula derivation, and did not re-examine the problem from a practical level: too much support, the pressure on the tires will also increase, driving on such a road , the vehicle will have the risk of tire blowout at any time.

3.3 Ideology and politics in physical experiments

There are some interesting experiments interspersed in high school physics teaching. These experiments provide valuable real-life experience for students to better learn and understand abstract physics concepts. Therefore, by adding ideological and political elements and integrating thoughts into actions, students' subjective initiative can be better played, students' analytical ability can be exercised, and students' innovative consciousness can be cultivated. It can be said that to do a good job in the teaching of experimental courses in high school is to lay a solid foundation for students to participate in scientific research in the future. For example, when talking about the free fall motion experiment, the teacher refers to the following to guide students to complete the experiment, so as to achieve better teaching effect.

First, the teacher leads the students to carry out the mathematical derivation of free fall: Galileo put forward two hypotheses to verify the relationship between physical quantities in free fall: $v \propto t$ and $v \propto x$. Considering $v \propto x$, that is, $x = v \cdot t$, the object moves in a straight line at a uniform speed; But in the process of free fall, the speed of the object continues to increase, which is contrary to the feature that the speed remains unchanged in the uniform linear motion. Therefore, the conjecture that $v \propto x$ can be derived by mathematical derivation is wrong. Considering $v \propto t$, the velocity of the object changes uniformly after a period of motion, and the instantaneous velocity at the middle moment is the average value of the initial velocity and the final velocity. If the object moves at the same speed for the same period of time, its displacement is the same as the displacement produced by the uniform acceleration with zero initial speed. Therefore, when a body in free fall has $v \propto t$, then $x \propto t2$. This is consistent with the phenomenon of free fall motion.

Secondly, the teacher led the students to review Galileo's experimental design: due to the fast falling speed, it was not easy to accurately measure the falling time under the conditions at that time. Teachers can guide students to think about whether it is possible to prolong the movement time of objects by increasing the falling height of the objects, and finally evaluate this approach is not feasible and reject it. At this time, the ingeniousness of Galileo's inclined plane experiment is reflected: Let the metal ball roll down from the top of the inclined plane, increase the same time interval and record its rolling displacement; Because the acceleration of the metal ball on the inclined plane is higher than that of the free fall. The acceleration is much smaller, so the time the ball is in motion on the incline is easier to measure. Through this method, Galileo conducted hundreds of experiments, and finally came to the conclusion that "the motion of the ball on the inclined plane is a uniform linear motion". The experimental conclusion is further generalized, the greater the inclination angle, the greater the acceleration of the ball; When the inclination angle increases to 90°, the

motion of the ball becomes a free fall motion.

Finally, the teacher instructed the students to use the dotting timer for the experiment: Hang the weight on the paper tape, place the dotting timer upright, release the hand and let the paper tape follow the weight to do free fall, and the dotting timer is placed on the paper tape. Leave evenly spaced dots on it. By looking at the distance between adjacent dots on the paper tape, it was finally found that the free fall motion of the weight satisfies the relationship of $x \propto t2$, so that students can personally confirm this conclusion with experiments.

4. Key points of high school physics ideological and political design

In the process of introducing ideological and political design into high school physics courses, the following key points need to be grasped at all times.

4.1 Goal orientation

Ideological and political design should strengthen goal orientation, with the goal of establishing students' scientific spirit, training students' scientific ability, cultivating students' scientific aesthetics, improving students' scientific literacy, and correcting students' scientific attitude, and implement ideological and political work.

4.2 Based on reality

Ideological and political design should be based on reality, with the help of the characteristics of high school physics, a basic subject that is close to real life, to combine abstract knowledge points in books with what they have seen, heard and felt in life, and guide students to be practical and down-to-earth, not to engage in metaphysics, idealism.

4.3 Organic combination

Ideological and political design should be organically combined with classroom teaching work, so that ideological and political work and teaching work resonate, and generate positive interaction and positive feedback between teachers and students. It is necessary to not only learn the course knowledge well, but also enrich the spiritual connotation, and not just imitate it, let alone one or the other.

4.4 People oriented

Ideological and political design is aimed at high school students. It must be people-oriented, and it is always clear that the purpose of ideological and political work is for the comprehensive and healthy development of students' morality, intelligence, physical beauty, and labor. It is necessary to show students in an appropriate way the positive attitudes that students are suitable to accept and are closely related to the curriculum. Energy content that cannot negatively impact student learning and development.

5. Conclusion

As an important part of high school curriculum ideological and political design, the ideological and political design of high school physics curriculum is an indispensable part of the educational work of "Lide morality and cultivate people". It must be noted that the starting point, the end point and the key point in the ideological and political design are interconnected, and it must not be neglected in the practice process. Each class should allow students to establish a scientific spirit, cultivate scientific ability, cultivate scientific aesthetics, improve scientific literacy, and correct scientific attitude in the process of mastering physical knowledge, so that students can develop in an all-round way under the new ideological and political pattern of the curriculum.

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