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The Derivation and Physical Meaning of Wave Function on College Physics Course Ideological and Political Integration

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Abstract. Many aspects of college physics teaching can be combined with moral education. The article integrates ideological and political elements into the teaching of college physics courses from four aspects, which can stimulate students' spirit of exploration and innovation, improve students' scientific literacy, cultivate students' scientific attitude of seeking truth from facts and establish a dialectical materialist world view. Take the derivation of wave function as an example, guide students to analyze from the perspective of dialectical materialism methodology, analyze the essence of wave from the micro level, and finally get the wave function. At the same time, from the physical meaning of wave function, students should be guided not to be tempted by foreign objects and adhere to their own hearts. Help them establish a correct outlook on life, values and world outlook. Then various educational elements are cleverly integrated into the teaching content to enhance the effect of education.

Keywords. College Physics Course; Ideology and Politics; Teaching Reform

1. Introduction

Physics is a natural science that studies the basic structure, basic forms of motion, interaction and transformation of matter. Its basic theory permeates all fields of natural science, applies to all aspects of production technology, and is the basis of other natural science and engineering technology. In the process of human pursuit of truth and exploration of the unknown world, physics shows a series of scientific world outlook and methodology, which has a profound impact on human's basic understanding of the material world, human thinking mode and social life. It is the cornerstone of human civilization development and plays an important role in the training of scientific quality of talents. College physics course is a public basic course of science and engineering for non-physics majors, which is characterized by long teaching hours and wide benefits. Moral education can be approached from basic concepts, theorems and laws in physics, physicists and history of physics, etc. All these have laid a solid foundation for the organic integration of physics and ideological and political elements [1-4]. As a method, ideology and politics can effectively improve the quality of classroom teaching, better complete the teaching objectives of the curriculum, and improve students' interest in learning.

In recent years, the research on curriculum in China's education circles has been

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quite hot, and teachers in various colleges and universities have achieved phased teaching results in different levels, directions and dimensions. For how to build high-quality online courses, their teaching team put forward a series of countermeasures and measures to improve the quality of course construction and teaching, and pointed out that the long-term construction, maintenance and service of high-quality websites also play a key role [5]. The implementation of undergraduate tutorial system can realize the combination of college teaching and moral education, make teaching according to students' aptitude and achieve the purpose of personalized training [6]. Through perfecting the college physics curriculum system, reforming the curriculum objectives, taking the selection of ideological and political elements and the elaboration of cases as the starting point for curriculum reform, a new path of reform is explored [7].

Many teachers have given their different views on the ideological and political teaching research of college physics course. Integrated the space frontier technology into the whole teaching link, reformed the traditional teaching methods and teaching contents, then achieved good results [8]. Introduced the way to integrate moral education into course under the background of "new engineering" and put forward her own thoughts on how to effectively carry out the teaching [9]. Put forward that the education category of course is outlook on life, values and world outlook, and the education goal is to seek truth, perfection and aestheticism, according to which the ideological and political elements of course are classified [10]. Taking electric field strength as an example, fully exploring moral education elements can give full play to the main channel function of classroom education, so as to realize the unity of knowledge education and quality education [11]. Takes thin film interference as an example to introduce the craftsman spirit through the application of thin film interference, enable students to appreciate the beauty of physical phenomena, the beauty of physical theory description and the beauty of theoretical structure [12]. Took circular motion as an example and explained the transition from circular motion to general curved motion on China's high-speed railway, so that students could understand the laws and characteristics of circular motion [13]. These studies provide new ideas for other teachers' curriculum construction.

2. Ideology and Politics Elements

In recent years, the physics teaching and research department of the university has carried out the experimental work of curriculum ideology and politics in the teaching of college physics courses and set up a teaching team. Through excavating various educational elements, they are cleverly integrated into the curriculum, so that students can shape correct outlook on life, values and world outlook in the process of learning knowledge. The course adheres to the fundamental task of cultivating morality and educating people, takes "environment educating people and making things silent" as the basic idea of course, and integrates the cultivation and practice of socialist core values into the whole process of teaching. The integration of various educational elements into curriculum teaching can be carried out from the following four aspects:

1) Patriotic education should be conducted to help students build the "four self-confidence" of socialism with Chinese characteristics, namely, confidence in the road, theory, system and culture.

2) Dialectical materialism education should be carried out so that students can master the scientific thinking method of Marxist philosophical principles. In the course

of explaining knowledge points, combined with the derivation of physical formula laws, students are guided to analyze and think about problems from the perspective of dialectical materialism.

3) Educate students on the core values of socialism and train successors of the socialist cause. To solve the fundamental problems of who to train, how to train, and for whom to train.

4) Conduct moral education. Moral education is an important part of course teaching, which cultivates students' correct outlook on life, values and world outlook.

3. Teaching Method

Classroom is the main channel to implement teaching. To achieve the effect of ideological and political education, the choice of teaching methods is the key. Make full use of a variety of teaching means to educate and edify students, help students correct learning attitude, establish a correct outlook on life, values and world outlook.

1) Using the online network platform, students can preview before class and review after class, and also expand extracurricular knowledge. Online learning platforms not only support classroom teaching activities, but also provide support for students to carry out mobile learning anytime and anywhere in the extra-curricular environment. Teachers set up online resources applicable to the school on the learning channel, push relevant learning materials before class, and push exercises and summaries after class to consolidate what they have learned in every class, realize the closed loop of course teaching, improve their self-learning ability and cultivate their self-management ability.

Moocs are a large-scale online learning platform, reviews some major research since 2010 and summarizes the findings. Currently, the number of students joining and completing the courses through online is significantly increased which showed that the learners' intention on getting the knowledge in the area of specialization has increased [14]. In addition, in the course teaching process, the course team will introduce some cutting-edge developments and topics into the teaching process to promote students to understand the connection between basic knowledge and frontier and enhance their interest in exploring frontier. Examples include gravitational wave detection, CCD technology, topological superconductivity, spin flow, and so on [15-18].

2) PBL teaching method combined with group discussion. PBL teaching mode is also known as problem-based learning [19-21]. By presetting problem situations containing teaching content, students cooperate and discuss in groups to solve problems together, thus achieving the purpose of learning. Compared with the traditional teaching mode, PBL teaching mode can more effectively stimulate students' learning interest, improve independent learning ability, cultivate teamwork consciousness, exercise scientific thinking and research and problem-solving ability. For example: What is the working principle of the Beidou positioning and navigation system? Speak in groups. This can stimulate students' interest in learning, improve students' scientific literacy, and at the same time, students can also experience the spirit of self-reliance and hard work of scientists.

3) Expository method. Teachers start from the most basic explanation, leading to ideological and political education, the perfect combination of knowledge transfer and value guidance [22, 23]. While helping students master the method of law application, it enables students to enhance the "four self-confidence", form a scientific world outlook

and methodology, grasp the physical thought and method, and finally play the teaching effect of "environment educating people and wetting things silently" [24].

4. Take the Derivation and Physical Meaning of Wave Function as an Example

4.1. Course Introduction Stage

The textbook used is "Physics" (7th edition), edited by Ma Wenwei, and the chapter is the wave function of 10-2 plane simple harmonics, which is the content after vibration, and students have a certain "wave" learning foundation. Push questions online before class, cooperate and discuss in groups as follows:

Question 1: If the mass point does simple harmonic vibration and satisfies the equation of motion $x = A\cos(\omega t + \varphi)$, what happens when put a vibration source into a medium? As shown in Fig.1.

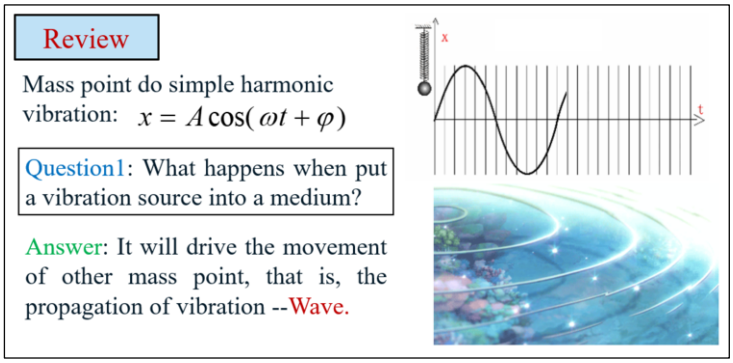

Figure 1. Review and introduce new content

Question 2: The wave source *O* does simple harmonic vibration, drives other points to move, what motion laws do the other mass points satisfy? How to find the equation of motion? As shown in Fig.2.

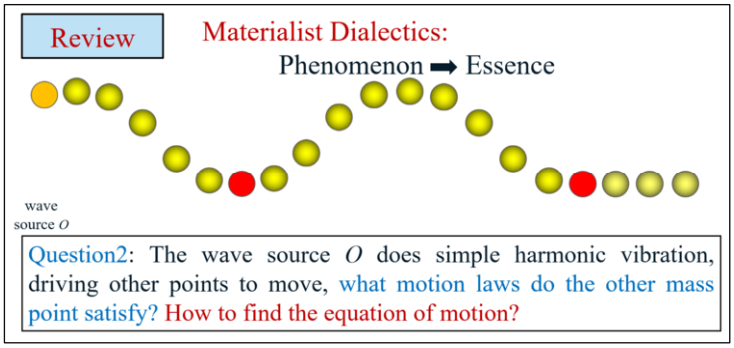

Figure 2. The nature of the wave phenomenon

4.2. Course Implementation Stage

1) Summarize the answers of each group, give the correct answers, and cause students to think.

For question 1, students will quickly find the answer. The wave source that vibrates in the medium will form a wave. The answer can be intuitively obtained from the production and propagation of water waves in the picture.

For question 2, it is suggested that students should use the methodology of dialectical materialism to find the essence of things from phenomena. Phenomena are the external relations and surface characteristics of things, essence is the internal relations between the fundamental nature of things and their constituent elements, essence is the basis of phenomena, and phenomenon is the expression of essence. The vibration of the source in the water can be seen to form a water wave and spread out, so what is the essence?

Through the explanation of question 2, it analyzes the methodology of dialectical materialism and looks at the essence of things from the micro level. Matter is made up of atoms and molecules, and the medium is considered to be made up of particles of the same size. Select a propagation direction for analysis, the vibration source does simple harmonic vibration in the equilibrium position, and the vibration of the vibration source will drive the movement of the surrounding mass points, because only the force of the vibration source medium, so the motion law is the same as the vibration source, that is, each mass point is in simple harmonic vibration, and the movement law of the vibration source is the same. But the starting states of each mass point are different. In order to find the vibration of all the mass points at any time, that is, the motion equation satisfied by each mass point, the concept of wave function is derived.

2) Definition of planar simple harmonic wave function and derivation of expression.

The wave surface is the simple harmonic of the plane, and the displacement of any particle in the medium (coordinate x) relative to its equilibrium position (coordinate y) changes with time, $y(x, t)$ is called the wave function of the simple harmonic of the plane. Each mass point is treated idealized, using the methodology of primary contradiction and secondary contradiction in contradiction theory, and each mass point is treated as that is only affected by neighboring particles in the direction of wave line, but not by other particles. Students are also required to pay attention to two aspects: first, what is the motion law of simple harmonic vibration; Second, what is the relationship between the particle on the wave line and the vibration source, can be analyzed from the perspective of phase difference or time difference. Students can easily analyze that the mass point on the wave line is also doing simple harmonic vibration, and the relationship with the vibration source is one phase behind in phase, or some time behind in time.

In order to derive the wave function for planar simple harmonics. First, discuss the simple harmonics propagating along the positive direction of the Ox axis, the source O is doing simple harmonic vibration, satisfying the vibration equation $y_o = A\cos(\omega t + \varphi_0)$.

Assuming that the medium is uniform and non-absorbing, then the amplitude of each mass point remains unchanged. In order to find the displacement of all the mass points at any time, arbitrary mass point P in the positive direction of the Ox axis, its distance from mass point O is x, and when the vibration propagates from mass point O to mass point P, mass point P will repeat the vibration of mass point O with the same amplitude and frequency. From the perspective of time, the time it takes for the vibration to propagate from mass point O to mass point P is Δt ($\Delta t = x/u$, u is the wave speed), in

other words, the vibration of mass point P at time t is the motion of mass point O at time (t-Δt). Therefore, the displacement of mass point P at time t is: $y_p = A\cos[\omega(t-\frac{x}{u})+\varphi_0]$. Since mass point P is arbitrary, the above formula is applicable to all mass point, and the above formula is called the wave function of plane simple harmonics. Derivation process is shown in Fig.3.

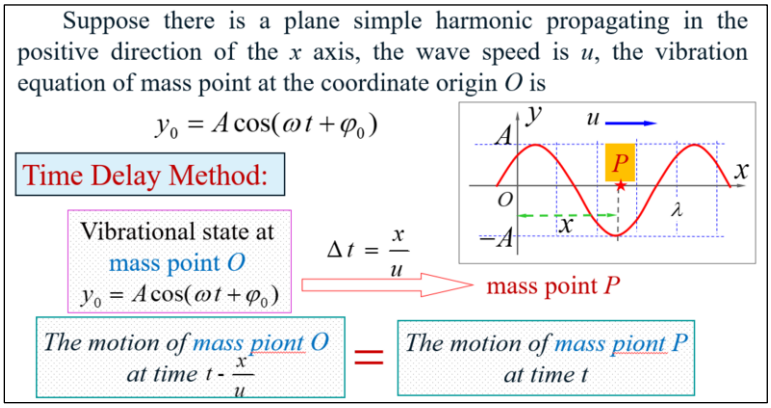

Figure 3. Wave function derivation process

If the wave propagates in the negative direction of the x-axis, then the vibration at mass point P starts some time before mass point O, so the wave function is: $y_p = A\cos[\omega(t+\frac{x}{u})+\varphi_0]$. To emphasize the origin and selection conditions of the plus and minus sign before Δt in the wave function, Let the students deduce the wave function from the phase difference, and judge whether the expression obtained is the same as the expression derived from the time difference, so as to arouse students' thinking.

3) The physical meaning of wave function.

From the above derivation, the expression of the wave function is obtained as: $y_p = A\cos[\omega(t\mp\frac{x}{u})+\varphi_0]$, from the physical meaning of the wave function to understand the propagation of vibration - wave. When x is constant, y is only a function of time t, and this equation represents the vibration equation of mass point x. When t is constant, y is only a function of position x, this equation represents the displacement of each mass point in the direction of wave propagation at time t, which is called the waveform diagram at time t. When both x and t are changing, the equation represents the displacement of each mass point at different times, that is, the waveform at different times, reflecting the propagation of the wave.

4.3. Summary Stage of The Course

1) From phenomenon to essence. The essence of the wave is that each mass point keeps doing simple harmonic vibration in the equilibrium position. Gradually learn to analyze problems with the methodology of dialectical materialism and look at the essence of things from the micro level. The scientific worldview and methodology demonstrated by physics are powerful tools for human beings to understand nature and nature, and embody scientific thinking methods for finding, analyzing and solving problems.

2) Stick to your heart and don't go with the flow. Each particle will not propagate forward with the wave, only sticking to its own position to glow and heat, and finally achieve the wave propagation. In the face of various temptations in today's society, we need to adhere to our heart, not to be affected by external conditions, not to be dominated by desire, and strive to be a pure and noble person.

3) Thinking: The wave function was derived from the perspective of time delay in class, and the wave function was derived from the perspective of backward phase after class, and the results derived from the two methods were compared.

5. Conclusion

Taking the derivation and physical meaning of wave function as an example, this paper shows how to integrate multiple educational elements into classroom teaching with various teaching methods. Introduce the topic from the generation of water wave phenomenon and guide the movement law of simple harmonic vibration learned in the previous chapter, so that students can think about its physical nature. From the Angle of materialist dialectics, we idealized the analysis and processing of the research object. Combined with the characteristics of wave propagation, derived from the time delay, the wave function of plane simple harmonics is finally obtained. Finally, the physical meaning of the wave function is analyzed, and students are warned to adhere to the self and not follow the crowd. In the teaching process, the initiative of students can be effectively mobilized, so that students can participate in teaching activities.

Compared with traditional teaching methods, it has the following three advantages: First, this teaching method can arouse students' thinking online in advance, and help students summarize and improve after class, cultivate good learning habits, and indirectly carry out moral education. Secondly, materialist dialectics is introduced in the teaching process. In the process of deriving the wave function, the idealized conditions of the research object are processed for many times, and the problems are analyzed in combination with materialist dialectics, so that students can master the use of Marxist methodology in the process of learning knowledge. Finally, starting from the physical meaning of wave function, it calls on students not to be confused by foreign things and insist on being themselves. In short, in the whole process of teaching cleverly interspersed a variety of educational elements, so that ideological and political and curriculum perfect integration, to achieve a very good teaching effect. The four aspects of ideological and political elements summarized in this paper can also be applied to other courses and provide a new idea for the construction of other courses.

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