

Common Mathematical Obstacles and Breakthroughs in Physics Teaching

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Keywords: Physics teaching; Mathematical obstacles; Mathematical breakthrough

Abstract: Mathematics is the basis of physics, and the defects of mathematical knowledge and ability are the main obstacles to learning physics. In physics education, the method of thinking is not only the important process, but also the scientific method of thinking. Many physical problems need to be solved with the help of mathematical knowledge for corresponding derivation and demonstration. The high school physics examination outline also clearly points out the examination of corresponding ability. There are also many physical problems that need to be solved with mathematical knowledge in the college entrance examination. The physics curriculum in colleges and universities also specially sets up the course of physical mathematical methods. However, there are essential differences between mathematics and physics, each with its own characteristics, and it is inappropriate to attempt to confuse the boundaries of disciplines. Mathematics and physics are two very important subjects in high school, and they are closely related. Whether in the expression of concepts or the calculation of exercises, the ability of mathematics affects students' physical achievements, so mathematics is an indispensable tool to learn physics well. In the investigation of the combination of mathematics and physics courses in the actual teaching process, we found that relatively speaking, there is a serious lag in high school mathematics knowledge. As far as the content of mathematics curriculum itself is concerned, it is also arranged according to a certain logical system and students' cognitive rules.

1. Introduction

Physics is not only a basic discipline, but also a leading discipline of natural science[1]. The main task of physics is to study the structure of matter, study the basic law of motion, express physical concepts and explain physical laws[2]. Physical quantities and their relationships are mostly quantitative[3]. Physical problems are often the quantitative relationship between physical quantities, which is always entangled with mathematics[4]. In the early stage of the development of physics, it was not a separate discipline, but a component of natural philosophy[5]. It was just an empirical summary of various phenomena in nature by virtue of intuition when people observed the world, without using much mathematical knowledge. Generally speaking, excellent students have sufficient mathematical knowledge and strong application ability, so they can learn physics easily; The middle and lower level students are lack of mathematical reserves and weak application ability, and physics learning is often difficult[6]. Now, all kinds of research progress in physics are always full of creativity and maintain vitality, which not only promotes our scientific and technological development, but also puts forward higher requirements for our educators on how to cultivate future scientific and technological talents[7].

Physics is a science based on experiments, and many basic laws are summarized on the basis of reality. The mathematical language is used to express physical laws and concepts, which makes the relationship between each physical quantity in quantity and essence more obvious and concise[8]. In order to explain the observed things and phenomena, or summarize the experimental facts and results into concise mathematical expressions, physicists use mathematics to represent the quantitative relationship of physical laws[9]. Or first establish a mathematical model according to physical phenomena, then make a prediction, then design an experiment according to the theory, and prove whether the prediction is correct by the experimental results, which are a series of data. The programmatic documents of basic education in various countries clearly put forward that we should pay attention to the cultivation of students' problem-solving ability, China's new curriculum

standards also clearly put forward "Advocate students to actively participate, be willing to explore and be diligent in hands, and cultivate students' ability to collect and process information, acquire new knowledge, analyze and solve problems, as well as the ability of communication and cooperation. In many years of teaching practice, the author found that the defect of mathematical knowledge and ability is one of the main obstacles for high school students to learn physics, mainly manifested in their inability to construct equations Function relationship, not skilled in discovering and using the relationship between geometric figures and establishing the mathematical image of physical process, lack of mathematical induction consciousness and the idea of limit and differentiation.

2. Common mathematical obstacles in physics teaching

2.1. Understanding physical formulas in a purely mathematical way

When students use physical formulas, they often put aside the physical meaning of the formulas, forget the causal relationship between physical phenomena expressed by the formulas, and mathematize the physical formulas, resulting in thinking deviation when using the formulas to analyze physical problems. The idea of equation is to analyze the equal relationship between variables in mathematical problems, to establish equations or equations, or to construct equations, to solve problems by solving equations or equations, or to analyze and transform problems by using the nature of equations. Equation is to seek static in motion and to study the equal relationship in motion. Many general concepts and laws of physics are expressed by mathematical formulas. According to the mathematical method of formula deformation commonly used in physics teaching, the known formulas can be transformed into new forms. The study of physics in senior high school needs to use all kinds of mathematical operation knowledge[10]. Besides the arithmetic of numbers and expressions, equations, inequalities and simple functions learned in junior high school, it also needs vector operation, power operation, exponential operation and so on. High school physics involves a lot of trigonometric functions and plane geometry knowledge of triangles in vector operation. Generally speaking, the research object of mathematics can be everything in the world or any form. We only need to separate the "surface" attribute of the research object before studying the problem, leaving only the essence of its "quantity", and then reflect them through accurate and clear concepts. The idea of mathematical equation requires us to extract the problem, analyze the mathematical characteristics, analyze and study the quantitative relationship in the specific problem and establish the functional relationship from the viewpoint of motion change. When learning some physical quantities, students often forget their physical meaning and understand the physical formula mathematically, resulting in the fuzziness of basic physical concepts.

2.2. There is no idea of forming mathematical induction

When facing some complex physical problems, students often don't know where to start to establish equations. For example, the electric field intensity of some complex motion, complex shape charged body, the magnetic induction intensity of general carrier fluid, and so on. The main reasons are the lack of students' mathematical application ability, the lack of basic mathematical knowledge, the inadaptability to quantitative calculation after entering high school, and so on. In order to more specifically understand the situation of students' application of mathematical knowledge to solve physical problems, through teaching diagnosis, find the problems existing in students' learning process, and improve students' mathematical application ability is an effective measure to promote physics learning. The ideal model will not be used to simplify the problem, so as to establish a solvable mathematical equation. It generally refers to turning complexity into simplicity, turning difficulty into ease, turning unknown into known, and so on. In the research of physical problems, many problems can be analyzed and studied with this idea. The research of physical situation pays attention to the basic principle of turning complexity into simplicity and turning music into straightness. Many concepts and physical quantities in physics, such as the motion of objects, internal and external forces, electric potential, potential energy and so on, are

relative and cannot be treated with the idea of absolutization. There are also many problems among students, such as random generation of formulas, making up hard sets; Regardless of the specific situation of physics, just calculate and completely mathematize the physical problems; The main reason why the knowledge in mathematics can't be effectively transferred to the middle level of physics is that "the teacher didn't explain clearly the physical meaning of the physical formula, the physical scene of the physical process, the connection of various stages of the physical process, etc." In sum, if we can consciously strengthen the application of mathematical knowledge and ability training in the process of learning physics, and constantly strengthen the combination of mathematical thinking dimension and two-way method and object comprehension questions, then learning physics will no longer be a difficult task. Figure 1 shows the difficulty of mathematics knowledge in physics learning at the present stage.

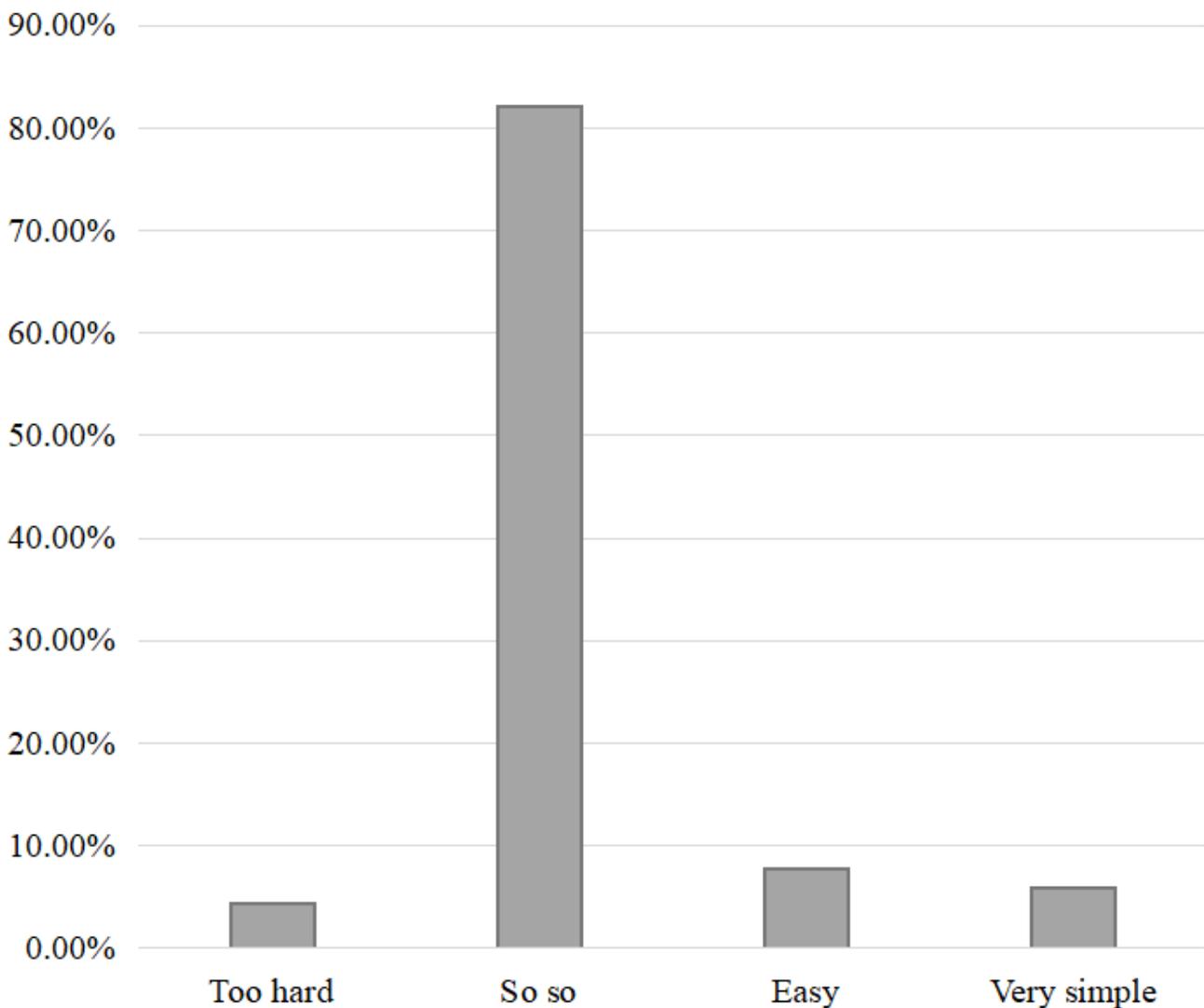


Figure 1 The difficulty of mathematical knowledge involved in physics learning

3. Some measures to break through mathematical obstacles

3.1. Giving prominence to physical thought in teaching

One of the main measures to overcome the common mathematical obstacles in physics teaching is to highlight the physical significance of physical theorems, laws and formulas in physics teaching, understand the causal relationship between them and the described physical phenomena and physical facts, clarify the context of the formula, enhance the physical color of the formula, and guide students to start with a thorough analysis of physical phenomena. From this, we can deeply

realize that Dewey has his own clear educational proposition in educational practice: the implementation of curriculum and teaching process should pay special attention to the education of scientific methods. The teaching of mathematical methods is basically studied as a whole with other scientific method education, and there is no independent research. Firstly, the establishment and development of physical theory need mathematics. Secondly, the elaboration of physical concepts and laws and the solution of physical problems also need mathematics. Let every student be clear: the application and development of physics need the support of mathematics; Without mathematical knowledge and methods, all aspects of physics learning will be affected. Methods and physics teaching, the content involves the function of mathematics in physics teaching, the problems in applying mathematics, the relationship between mathematics and physics, etc. In the process of physics teaching in senior high school, we should choose some typical physical problems that are suitable for life as examples, so that students can correctly understand physical concepts and laws by combining mathematical reasoning with life practice, and at the same time, we should also make students clear about the conditions needed when these concepts and laws are established in the application process. For those students who only pay attention to the accumulation of mathematical knowledge and methods but can't apply mathematics to the process of learning physics, they should give guidance and actively cultivate students' ability of self-study and knowledge transfer. In short, it is very necessary to infiltrate the teaching of mathematical methods into the physics course of senior high school. It is an important aspect of physics teaching. It not only meets the requirements of the new curriculum concept and examination outline, but also is an important supplement to quality education. It can also overcome some problems existing in current teaching to some extent.

3.2. Physics of mathematical conclusion

Because the solution is a physical problem, we should go back to the physical problem for further analysis and discussion, and check the authenticity, reliability and rationality of the results after applying mathematical methods to get conclusions through calculation. One of the ways to influence mathematics is to apply and transfer the knowledge and methods of mathematics to the study of physics. The difference between average students and top students in problem-solving ability is not the difference of basic knowledge and declarative knowledge, but the difference of problem-solving thinking strategies. Therefore, the goal of classroom teaching requires students not only to acquire knowledge and skills, but also to teach students how to use some problem-solving strategies. Mathematical methods teaching certainly meets the requirements of quality education. The improvement of a person's quality is not achieved overnight, but gradually accumulated. Therefore, teaching students mathematical methods is also a part of the contribution to quality education. Using the thinking of separation and combination, the complex physical problems are decomposed into the combination of simple problems, and the dimension of multi-dimensional problems is reduced, which is convenient to turn complexity into simplicity. Using mathematical methods, through the analysis of simple problems, the transition to the solution of complex problems. Since the lag of mathematical knowledge is common in high school physics teaching, when teachers encounter such problems, they should first supplement and summarize the corresponding mathematical content in order to eliminate the obstacles of mathematical content to physics learning. Some contents will be involved in the mathematics class first, and then the students will unconsciously use them in solving physical problems. In the process of solving problems, the mathematical contents are used, which also promotes the improvement of mathematical knowledge. In high school, some mathematical problems can be solved by physical ideas and methods. Deepen the understanding of basic physical concepts and laws, so that students can obtain greater gains through problem solving.

4. Conclusions

Most of the mathematical methods involved in physics are basic methods of mathematics, and the ability to solve physical problems with mathematical methods is an important ability. The above analysis and discussion will help break through the common mathematical obstacles in physics

teaching, and provide guidance and help for teachers to teach physics well and students to learn physics well. Generally speaking, the fundamental reason why the development of physics can not be separated from mathematics is that physics needs to be explained by mathematical language, which is the basis of physics. But this is not unique to physics. Mathematics is the language that describes all sciences. We should pay attention to guiding students to combine the functional relationship between the two physical quantities with the image to analyze the problem, let students find out the hidden physical meaning from the shape, change trend, slope, intercept, area, intersection, inflection point and other characteristics of the image, and cultivate students' ability of number shape combination. When preparing lessons, teachers should first fully understand the mathematical content required for the learning of this part of physics content and the students' understanding of these mathematical contents. According to the above situation, logically design the teaching sequence, adopt appropriate teaching methods and write clear teaching plans. I hope this paper can provide specific and feasible guidance for the majority of high school physics teachers, high school students and their parents.

Acknowledgements

Yibin University high level talents sailing plan project: Research on ultra-high sensitivity sensing technology of quantum weak measurement (NO:2021QH05): Theoretical study on the properties of carbon nanotube resonators and quantum dots under strong coupling (2021QH08)

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