Increasing the Creative Thinking Ability of Students via the Conceptual Teaching Method

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Keywords: College Physics Experiment Teaching, conceptual Teaching Method, ability of creation, design the experiment.

Abstract. The traditional physical experiment teaching mode has already hindered the cultivation of creative talents seriously. Introduce the conceptual teaching method to the experimental class of physics will create a completely new physics experiment teaching mode. This article introduce the method of conceiving teaching and the function of training students’ ability of thinking independently, creation, analysing and solving problems.

Introduction

With the coming of the knowledge economy and information, a higher requirement is called in college education. Practical, comprehensive, innovative abilities become the tad of the qualified persons. So the training of highly qualified person with initiative and creativity is the priority of higher education.

In science and engineering teaching of modern college, experiment of college physics is one of the most main courses to enhance the students' practical ability and improve the students’ independent innovation ability. It has become the first topic of physical teaching in modern college, which is how to make the physics experiment teaching in school meet the requirements of the modern world and train all kinds of constructive talented persons with logical thinking ability and practical ability to adapt to the development of modern society. But for the moment of physics experiment teaching of domestic college, the traditional teaching mode and teaching method has not well adapt to the training needs of the innovative talents in modern society. Although there have been some improvements of college physics experiment teaching in these aspects, it still faces many problems to be solved.

How to use the implementation of new ideas, how to cultivate innovative talents, how to issue new teaching methods, how to put more conducive to the development of the students teaching methods used in concrete class have become an important part of the experimental reform.

As time progresses, students have developed the habit of passively accepting knowledge and performing experiments. Many students do not consider the use or purpose of an experiment, the reasons why a particular experimental method is used, the advantages and disadvantages of this method, or if better methods are available. Such attitude has considerably affected the development of independent thinking and creative analytical ability among students and has reduced their interest and initiative in conducting experiments.

Reform method

Therefore, we have attempted to improve the means of teaching experiments by shifting from the traditional approach to the conceptual teaching method. In the latter, the teacher will initially raise questions and allow the students to consider and decide which experimental method should be used to
obtain the required experimental results based on the knowledge they have gained instead of directly describing the objectives, principles, methods, and steps of an experiment to the students before it is conducted. By the end of the class, the teacher will assess the feasibility, advantages, and disadvantages of the experimental methods designed by the students to determine which methods are reasonable and to compare them with established methods. For example, when teaching “the measurement of resistance using the bridge method,” the teacher will first allow the students to measure the value of an unknown resistance, and then analyze the advantages and disadvantages of the typical “voltammetry resistance measurement” that they have designed. The teacher will then raise questions for the students to contemplate and answer according to their design plan. At the end of the session, the teacher will introduce “the measurement of resistance uses the bridge method” to the students and allow them to compare it with the other designed methods.

In another example, when measuring the specific heat capacity of solids, the teacher will initially allow the students to design a measurement technique for the heat capacity of an unknown metal. Once the students have developed various methods, the teacher will organize the students and ask them to discuss and analyze the rationality, feasibility, accuracy, advantages, and disadvantages of these methods. Then, the teacher will introduce the method that will be adopted in class and ask the students to compare it with the methods that they have designed. In this manner, the students will be able to analyze the advantages and disadvantages of the established method, and consequently, propose better methods. Through this practice, the ability of the students to analyze and solve problems will be trained and their initiative and enthusiasm will be developed. Even if the students fail to design a reasonable experimental plan, this approach will have far-reaching significance in developing the comprehensive experimental design ability of the students. We have selected several experimental design subjects for the students and provided some of the necessary instruments to enable them to design their own experimental plans. They can select the experimental instruments, write the experimental content, establish the experimental principles and steps, and measure the experimental data and results according to their design plans. Finally, the students will write their report or thesis.

The teacher will assess the reports or theses of the students. Then, he/she will organize the students to discuss the feasibility, advantages, and disadvantages of their designed experimental methods as well as to determine the accuracy and reliability of the results. Afterwards, the students will share their opinions and propose suggestions for improvement. For example, in a design experiment called “the measurement of density for an unknown metal sphere,” the students are required to obtain the density accurately without damaging the shell of the sphere. The students start brainstorming after the problem is presented and draw various design plans. Some students believe they can obtain density by measuring the mass, diameter, and buoyancy of the sphere. Others believe they can determine density by using the density comparison method or the resistance measurement method although they have not yet obtained the experimental results. Some students propose that the specific heat should be measured first using the specific heat method and then the density of the metal sphere can be obtained by comparing the result with the specific heat chart for metals. Other students suggest conducting spectrum analysis to measure the characteristic spectrum of the metal sphere and to determine what kind of metal it is according to its characteristic spectrum, and finally, obtain the density of the metal sphere. Some students recommend using an ultrasonic thickness gauge to measure the thickness of the shell and calculate the volume of the metal sphere. Then, a balance is used to measure mass, and consequently, obtain density. The aforementioned methods are all feasible experimental plans. The teacher will then guide the students in comparing and analyzing the proposed experimental plans and results to identify the best method. This approach does not only develop the independent creative thinking ability of the students but also widen their perspectives by consolidating their previously obtained knowledge. Therefore, we believe that we should aggressively promote this method for experimental teaching in the future.
Acknowledgement

This research was financially supported by the Dalian Ocean University.