The Study and Practice of the Teaching System Reform of the College Physics Experiment

Zhong-Ying YUAN

Mechanical College. Liaoning Institute of Science and Technology. Benxi, Liaoning, China
lkyyzy@126.com

Keywords: College Physics Experiment, Multi-level Teaching Model, Comprehensive Experiment, Design and Research Experiment.

Abstract. This paper sets up a new teaching system of college physics experiment, advances gradually in multi-level order, cultivates students’ experimental skills, and improves hands-on practical abilities. Through basic experiment, comprehensive experiment, design and research experiment and the implementation of open experiment teaching, the students are trained to possess the innovation spirit of exploring, studying and learning.

Introduction

In order to cultivate innovative application-oriented undergraduate talents, we break through the traditional experiment teaching mode, and set up the basic, comprehensive, design research of progressively improved open type teaching mode. The mode of teaching can stimulate students’ experimental enthusiasm and initiative and improve the students’ abilities of innovation and practice.

Basic Experiment

Through the creation of “length measurement”, “the use of a multi-memer”, “the use of the oscilloscope”, “adjustment of spectrometers and use”, “determination of Young’s modulus of metal materials’ and “the measurement of moment of inertia of rigid body” experimental projects[1], this level of experimental teaching focuses on letting students learn basic physical quantity measurement (such as length, mass, and time, etc.), the use of basic experimental instruments, the basic experimental skills (such as zero adjustment, level, vertical adjustment, eliminating parallax, coaxial regulation; circuit connection, etc.), basic methods of measurement (such as comparative method, amplifying method, compensation method, switching method, simulation method, etc.), the theory and the methods of error analysis, uncertainty and data processing. At this stage of teaching, we adopt comprehensive explanation (using multimedia classrooms on the experimental principle, method, steps and matters needing attention), teacher demonstration method. Students adjust apparatus and measure data, analyze data, and complete the experiment report according to the teacher’s guiding. After a period of training, we’ve realized the cultivation of the students on basic experiment knowledge, the basic skill of experiment and the basic experimental methods and the scientific attitude of seeking truth from the facts, and all these lay a solid foundation for all the experimental study.

Comprehensive Experiment

Comprehensive experiment means experiment involving mechanics, thermotics, electromagnetism, optics, and many other fields of knowledge in modern physics in the same experiment, and the application of multiple methods and technology comprehensively. [2]

Through the integration of the experimental content, method and means, we enable students to master the comprehensive knowledge and skills, cultivate the mode of comprehensive thinking, and promote students’ coordinate development on knowledge, quality and ability. During the experimental teaching of this level, “Frank Hertz experiment”, “Research on polarized light”,

26
Designing and Research Experiment

The designing and research experiment is that the students apply the knowledge learned to access to reference materials independently according to the guidance of teachers, and design experimental project independently, select the experimental equipment independently, or assemble of them on the basis of the existing experimental conditions, design operating steps of the experiment independently, and complete the experiment within a specified time[3]. After the experiment was done by the students, we ask the students to write a complete experimental report in the form of paper, analyze and summarize the experimental results systematically, in order to enable the student to experience the basic training of a science experiment course[4]. At this level, through the setting up of “Determination of coefficient of viscosity of liquid” (The falling ball method, rotating cylinder method, capillary method etc.), “Determination of moment of inertia” (The falling ball method, three wire pendulum method, compound pendulum method, torsion pendulum method, etc.), “Determination of the surface tension of liquid” (Jolly Balance method, the ring method, capillary tube method, torsion balance method, etc.), “The small length measurement” (Optical lever method, Michelson interferometer, optical fiber displacement method, etc.), “Measurement of liquid refractive index” (Grazing incidence method, Newton method, spectrometer method, Michelson interferometer method, etc.) and other experiment projects[5], we stress on students’ experimental design ideas and experimental phenomenon only for guidance and advice, and provide a good experimental teaching environment for them. Students complete experiment projects design, implementation and get the conclusion through independent research, the integrated use of multi-disciplinary knowledge and skills. During the whole experiment, we cultivate students’ quality of discovering and solving problems, stimulate students’ innovative potentials, train their innovation abilities. Designing experiment opens up students’ innovative consciousness, develops students’ personality, improves students’ hands-on practical abilities and creativity, trains and cultivates the ability of graduation design, writing scientific research achievement report and academic papers preliminarily.

Implementation Safeguard of the Multi-level Teaching Model

Laboratory Opening

In order to ensure the smooth implementation of the multi-level teaching model, we used the opening of laboratory and the matching. In addition to guarantee work time full when open, laboratory is also arranged to be open sometime at night. Students can choose, according to their specific situations, the appropriate time to go to the laboratory, get knowledge and understanding of the instrument and equipment and experimental content, study autonomously and operate independently. That can allow the poor students enough time to practice the basic and practical skills, let them practice more, put hands-on more and operate more in order to guarantee their basic
experiment diathesis and the cultivation of their skills. For the outstanding students, in the completion of basic training requirements under the premise and in-depth study, we strengthen the cultivation of innovative awareness and capability. Laboratory opening promotes students’ subjective initiative into full play, and promote the exercising of their initiative. The openness of the laboratory maximizes students’ own potential, thus students of different levels can be further improved on the basis of their original ability.

The Construction of Experiment Teaching Team

On the open experiment teaching, the students will have a variety of problems requiring teachers for help, this requires the experimental teachers should have a solid theoretical foundation and rich practical experience. Before class, experimental teachers must be familiar with the relevant principles of physics experiment, experimental theory and the equipment. Besides, they should have a strong practical and problem-solving ability. Especially in the designing and research experiments, the teacher should consult relevant reference to design all kinds of possible solutions at the beginning of releasing the experimental subject, try on the various schemes, analyze and make a comparison of advantages and disadvantages, understand the difficulties and any problems they may have in the experiment according to the students’ level of knowledge, experimental skills and design of experimental content, and know fairly well about the solving of the problems to guide students effectively. In fact, guiding the students to solve the problems is the process of teachers’ learning process. Therefore, the teachers should establish the concept of lifelong learning, strengthen the academic accomplishment, and improve the technical level. Indeed, the construction of experiment teaching team -- improvement of teachers’ professional level and research ability is the fundamental guarantee of the open experimental teaching.

Epilogue

The open multi-level teaching of college Physics experiment provides the platform of integrated comprehensive experimental skills and the concept of internalization. The open multi-level teaching improves the utilization ratio of the equipment, cultivates students’ thinking and creative ability gradually, promotes students’ autonomous learning and scientific research consciousness, and strengthen the students’ practical ability and the cultivation of innovative ability.

References


