

Experimental Reform of the Course " Engineering Materials and Moulding Technology Foundation" in the Information Age

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Abstract

The experimental processes of the course "Engineering Materials and Moulding Technology Foundation" are relatively complicated, and the teaching is difficult in the limited time. The simulation experiment and comprehensive experiment and other modern teaching means introduced, the multimedia teaching way used, examples about failure analysis and new materials developing joined, experiment examination way reformed, these measures strengthen the cognitive teaching, and form " model cognition-simulation virtual-practice operation" with the combination of new experiment teaching methods, and students know how to apply theories in practice well.

Keywords

Model Simulation; Failure Analysis; Open Comprehensive Experiment; Multimedia Teaching.

1. Introduction

21st century is an era of information and knowledge. Students and teachers all face new opportunities and challenges then. According to the requirements of "the Ten-year Development Plan for Education Informatization (2011-2020)", universal education, excellent quality education, mixed learning, mobile learning, personalized learning and lifelong learning have become important features of modern education development. It is a good opportunity for students to set up good moral characters and improve professional quality. Experimental teaching plays an important role in higher engineering education and is the main link to train students' practical ability and innovation ability. The experimental process of " Engineering Materials and Moulding Technology Foundation " is complicated and time-consuming, with many instruments and equipments, so the methods of experimental teaching are needed to be updated constantly. Therefore, the opened experimental teaching mode of "model cognition-simulation virtual-practice operation" is adopted to improve the teaching effect and give full play to the enthusiasm and initiative of students.

2. Status Analysis

There have mechanical design and manufacturing engineering, mechanical electronics engineering, process control engineering, mechanical engineering, intelligent manufacturing engineering majors in the Mechanical Engineering and Automatic College. All the teaching activities focus on the equipments mainly used in metallurgical enterprises. Experimental teaching includes Mechanical Principle, Hydraulic Control and other basic experimental courses as well as Engineering Materials and Moulding Technology Foundation, Computer Virtual Simulation, Mechanical Training and other professional experimental courses. These experimental courses are related with many basic knowledge principles and modern advanced technology, and the experimental knowledge, skills and methods involved, that are the foundation for students to engage in scientific research and engineering practice in the future. In the past teaching process, teachers of various experiments were only responsible for their

own part of the teaching, the content was not smooth, the knowledge system was not systematic, just for the sake of doing experiments, and rarely introduced the problems in actual production into the classroom. Students had not enough attention and interest in experimental courses, and they just finished the experimental reports for a perfunctory way, which resulted poor teaching quality.

Higher engineering education must take into account the position, function and task of experimental courses in the process of training for mechanical majors students. It is necessary to construct and optimize the experimental teaching team, construct the hierarchical curriculum system, explore the experimental open teaching mode, keep pace with the times, and combine the modern production mode of enterprises. That is these experiments of Engineering Materials and Moulding Technology Foundation, Mechanical Training, Computer Virtual Simulation and so on are combined, the production models are introduced, the model of cognitive, virtual simulation, training operation of new experiment teaching methods are set up, carrying out an opening teaching step by step in the process of experiment, enhance the comprehensive understanding of professional knowledge sensibility, which can improve the quality of experimental teaching effectively.

3. Experimental Reform

In order to change the current situation of experiment teaching, and make the teaching effect more following up with the development of modern technology, the school and the teachers responsible for experiment teaching these courses have proposed and implemented the following reform measures under referring to the experience of other institutions [1-3].

3.1. University-Enterprise Training bases and Virtual Simulation Experiment Construction

The school has built 4 demonstration and training bases with a number of enterprises to carry out school-enterprise collaborative education. There has CNC single machine→machining center →logistics sorting system→industrial robot system→intelligent manufacturing production line to form advanced manufacturing technology teaching hardware and software resource chain step by step; and a teaching chain in the industrial automation field from PLC basic programming training→multi-task linkage→electromechanical integration→logistics sorting system→ industrial robot→intelligent manufacturing production line also. At the level of mechatronics control integration, advanced manufacturing technology and industrial automation and industrial robot technology can be integrated through logistics sorting system, industrial robots and intelligent manufacturing.

In addition, with the popularization of computer and the development of network technology, a new experimental teaching method-virtual simulation experiment arises, which makes people learn more abundant resources, more diversified learning forms, more flexible learning arrangements. It has advantages shown as follows mainly:①Bringing the production site into the course teaching process can reduce the cost of experiment and practice, reduce the risk of accidents caused by extremely dangerous experiment and practice, and avoid the ineffective waiting of time-consuming and energy-consuming experiment and practice projects.②During the use of virtual simulation experiment, students are not worried about the damage of equipment, can enter the virtual laboratory at any time, anywhere for virtual experiment operation, and can do their own project without the limit of the teacher's assignment, enrich the experiment content, broaden students' academic horizon.③Break the traditional experiment mode, students are no longer restricted by time and space, can enter the virtual laboratory at any time, anywhere for virtual experiment operation, no longer subject to the limitation of classroom time, promote the openness of the laboratory.

At present, the virtual simulation laboratory of our school has begun to take into shape, with a special virtual laboratory and special teachers. The virtual simulation is mainly carried out on the iron and steel metallurgical production line, so as to truly reproduce the whole production process from ore mining→smelting→rolling forming→material inspection and so on. Combined with the corresponding physical model, the teaching mode of virtual experiment and physical experiment greatly deepens students' impression on equipment and technology, improves students' learning and understanding ability, stimulates students' initiative, effectively improves the quality of experimental teaching, and truly achieves the combination of theory and practice. It lays a solid foundation for the new experimental teaching mode of "model cognition-simulation-practice operation". Some concepts are also established for the process, equipment, instrument and other complex process experiments in metallurgical plants and manufacturing fields. In order to give full play to the location advantage of the school located in Anshan-the core area of Iron and Steel, students can be organized to visit the enterprise before and after the experimental classes, and briefly introduce the process, equipment and instruments involved, so that students have a deep understanding of this, learning will not feel too abstract. This is also in line with the provincial economic construction planning, and will provide excellent technical and management personnel for local economic development.

3.2. Applying Multimedia Teaching Means to Strengthen Production Cognition Teaching

Multimedia teaching methods could enable students to obtain three-dimensional visual effects and sound effects in the classroom, so that the teaching is simple and easy to learn and understand, it have been always used for many years. Due to the course is very common and practical in factories and the working environments are very dangerous, many enterprises are not willing to accept students into practice and visit. It is well known that no one enterprise can cover all the production technologies. And a lot of knowledge about materials is very abstract, so multimedia teaching can make up for this deficiency. According to the requirements of the teaching syllabus and the content of the teaching materials, hundreds of animations and teaching videos have been collected and compiled. At present, the multimedia teaching method integrates animation, video, image and sound, which can stimulate the brain from auditory and visual aspects and leave a deep impression on students. At the same time, some videos about new technologies, new processes, new materials domestic and abroad are shown during the teaching, students are surprised and impressed. It can be seen from the video that the strength of annealed spring is very low, and cannot be sprung after being compressed by force; then continue to harden to improve the strength, but the brittleness is very large, directly broken under external force; finally, after the tempering, the spring behavior is the desired performance, the intuitive effect directly reflects the effect of heat treatment on performance. In the video, we can also see the advanced technology of drawing cold heading wire of bolts on airplanes, upsetting rolling of super-large diameter rings, construction of cable bridges and so on. Of course, students can be arranged to go out to visit and study if possible.

3.3. Add Comprehensive Experiment for Better Basic Knowledge

Changed the original heat treatment experiment into a comprehensive experiment "Heat Treatment Process Design and Forming Method Selection". No.45 steel usually used is desinged for different purposes, and therefore different heat treatment is needed, and then to determine tensile test, hardness, observation of metallographic microstructure and so on. The students could master the steel composition, microstructure, heat treatment, the performance of the relationship between knowledge from material composition-metallographic specimen preparation-heat treatment-microstructure observation and mechanical performance testing. The situation of relatively single and relatively independent experimental projects in the past has been changed through the reform and exploration of the comprehensive experimental

teaching mode of this project. And different experimental contents completed in different labs and different links have been organically integrated together, laying a solid foundation for students to select materials and use materials better. In the implementation of the project, students are trained in basic experimental skills such as preparing metallographic samples, using microscope, observing and taking metallographic structure and metallographic photos, preparing tensile samples and testing mechanical properties by realizing resource sharing between the laboratory and the engineering training center. Students are preliminarily trained to understand the role of metallographic analysis technology in material production and mechanical product manufacturing too. The experimental scheme that organically combines the basic teaching experiment with the practical engineering problems is not only beneficial to enrich the content of experimental courses and broaden students' horizons, but also can improve students' ability to analyze and solve problems, so as to cultivate their engineering quality and innovation ability.

3.4. Emphasized the Role of Experiment in Failure Analysis and New Material Research

It is shown that materials have great influence on the development of human society and the application of high and new technology by collecting some examples from the actual production and use of materials. For example, Dr. Xun Li, the founder of the Metal Institute of Chinese Sciences Academy, had done a lot of experimental study on aircraft engine shaft fracture in 40's last century in UK, found the mystery and rule of the hydrogen embrittlement in steel, proved that the steel internal hair crack is caused by the presence of hydrogen. This discovery has always had a significant influence on steel metallurgy technology by now, and he has received important honors for himself and Chinese in the world too. The lunar module is wrapped in a golden foil of polyester film called Mylar, which provides good insulation from the extreme cold. Without these special materials and surface technologies, the dream of traveling into space would not be realized at all. In addition, disaster analysis reports of engineering accidents and corresponding technical improvement measures related to this course in the world are collected, such as the railway breaking accident in Hokkaido during the Meiji Restoration period of Japan, the Columbia explosion accident, the Titanic shipwreck accident and so on. It is to use the operational skills and theoretical knowledge learned to analyze the manufacturing process, service conditions and failure forms of failure cases, put forward improvement plans, write a complete analysis report, and train students' comprehensive analysis ability. On the one hand, the analysis of accidents can increase student knowledge and prevent the occurrence of similar accidents. On the other hand, it can enhance students' sense of social responsibility and take responsibility for the products they design.

3.5. Reform the Way of Experimental Assessment

There are about 500 students every grade in my school. It is impossible for everyone to have one microscope and heat treatment equipment, so it is also impossible for every student to conduct the experimental examination through operation. Generally, experimental reports is used to assess students' mastery of knowledge points. However, such assessment method will inevitably create opportunities for students who plagiarize reports, fabricate data or only write reports but do not know how to operate them. In order to really assess each student's mastery of the experiment, the experimental operation process is described in detail in the form of written or oral answers, and then the on-site scoring is carried out according to the students' answers. In the comprehensive experiment conducted in groups, which involves a large number of participants and takes a long time. Members of each group are allowed to evaluate each other and themselves according to the requirements of normal distribution of scores, which is not only an opportunity to learn knowledge, but also a way to find gaps and improve themselves through comparison. On this basis, the instructor will weigh and adjust the quality of each

group. This kind of examination method not only encourages students to do the experiment enthusiastically but also can truly reflect each student's experiment operation ability.

4. Conclusion

This experimental teaching reform on Engineering Materials and Moulding Technology Foundation course is a new mode of experimental teaching paying attention to improve students' professional quality, practical ability training. It is beneficial to the cultivation of students' comprehensive quality and the improvement of analysis problem, problem-solving skills, and fully mobilize the students' learning initiative and enthusiasm, enhance the interest in learning, promote the virtuous cycle of development. This reform is worthy to be lasting on.

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