Enlightenment of German University Industrialization Laboratory to the Training of Excellent Talents

Cai-li YU¹,a

¹School of Mechanical and Energy Engineering, Zhejiang University of Science and Technology, Hangzhou, China

ǎzustycl@163.com

Keyword: Applied Talents, Integration of Industry and Education, Industrial Laboratory.

Abstract. German university of applied sciences is a closely integrated with the practical application of the type of higher education, is also a kind of developing great engineers education mode, mainly "university-enterprise cooperation project" deduction "personnel training project", especially the depth of the industrialization of German university of applied sciences laboratory education embodies the "convergence" education practice mode. By Zhejiang institute of science and technology and the German university of applied sciences has nearly 40 years of cooperation in running schools, the students with the ability for this, guided by the demands of social industry, has a strong practical ability of outstanding talent, draw lessons from the German university of applied sciences high-level personnel training mode, put forward China's application of colleges and universities to strengthen the engineering practice teaching, pay attention to practice teaching contents and reform teaching methods, to improve the students' practical ability, innovation ability and social adaptation ability conception.

1. Characteristics of Industrial Laboratories in German Universities

Since the 1970s, the laboratory construction in German universities has reached a climax. The number and scale of laboratory construction have increased, and the laboratory construction has taken the industry as the background, carried out school-enterprise joint establishment of industry-education integration laboratory, carried out scientific research activities and technological innovation, and adhered to the educational principle of "combining research with teaching" to carry out experimental activities.

1.1. Construction Objective of Industrial Research Laboratory of German University

In this respect, it can be traced back to the university of Harle founded in 1694 by Tomasius, who said that his aim was to combine science, university education and practical production closely[1]. All along, the establishment of German university laboratory has realized the system of organic combination and integrated development with science and technology and economy. Industrial research laboratories provide smes with strong support for scientific research and new product development. World famous brands such as Siemens Electrical and Khuber Guns from Germany are inseparable from scientific and technological research and development. At the same time, students in the laboratory to learn a lot of practical knowledge, for the future to serve the community to lay a solid foundation.
1.2. German Universities should Reasonably Arrange Experimental Courses with Independent Working Ability

The experimental class schedule in German universities is usually half a day to a whole day or longer, and students must make full preparations and complete relevant experimental preview reports before the experiment. In order to budget experimental data, they need to refer to 20-30 pages of experimental data. In terms of experiment allocation, each group will have different experimental data, so each group will have different experimental results, students have to prepare their own experiment honestly, do not have the illusion of others to "steal" the data and copy the results. So the students in each group were devoted to their own experiments and discussed and analyzed the problems they encountered. Through such continuous training, students have a strong ability to carry out independent experiments and research, which lays a solid foundation for graduation design and practical application of engineering.

1.3. It has Unique Experimental Guidance

In the experimental teaching process of The German University of Applied Sciences, students borrow equipment instructions from professors and teachers for new experimental instruments and equipment, and look for the information they need from the tedious instructions[2]. According to the instructions in the manual step by step to explore and operate. In this way, students can learn to think and solve problems independently, try their best not to bother others, and become competent engineers after graduation.

1.4. Strict Experimental Assessment Mode

In the evaluation of experimental teaching in German Applied University, different experimental course professors have their own evaluation standards. Some students are required to have an oral examination for each student. If the examination results are not satisfactory, students are asked to prepare for the review, make an appointment with the professor and come to the laboratory for oral examination and experimental operation alone (this requires a period of full preparation). Those who are serious are directly regarded as unqualified by the professor, that is to say, the students are not capable of completing the experimental course, and are required to retake the experimental course next semester.

After each experiment, the students were asked to write an experiment report. After the oral exam, the professor will give different marks to the students in the same group according to each person's level. Some teachers also ask students to design an experiment title by themselves, and introduce the experiment written and directed by themselves in the form of speech, which serves as the basis for assessment. In this way, students are required to be proficient in the experimental content, develop and innovate.

2. Enlightenment for the Cultivation of Outstanding Talents in Chinese Universities

Zhejiang University of Science and Technology has been cooperating with Germany for a long time. It insists on learning and drawing lessons from the mode of running school of German University of Applied Sciences for a long time. Relying on the innovative practice system, Zhejiang University of Science and Technology explores the cultivation of outstanding engineers and has distinctive characteristics in the cultivation of outstanding talents[3].
2.1. Strengthen Engineering Project Training and Cultivate Engineering Practice Awareness

Engineering training courses are arranged in the second or third semester according to the nature of the major. Students should learn basic operation skills as laborers, improve their operational ability and increase practical knowledge. Accumulate perceptual knowledge of enterprise management, production operation, equipment, technology and other aspects, cultivate the ability of combining theory with practice. Through the school, the internal and external practice base, and appropriate arrangement and practice related theory teaching.

2.1.1. Campus Practice Base

All kinds of internships in the campus practice base are strictly in accordance with the requirements of the teaching syllabus, so that students can do practical operation one by one, explain the relevant theoretical knowledge of production technology and engineering drawing on the site, and finally produce product-based results, focusing on cultivating students' hands-on operation skills and the ability to combine theory with practice. Students majoring in engineering are required to practice metalworking and electronic electrician in the corresponding practice base on campus. In particular, the reform of the past metalworking practice courses, engineering project training, to each student product production task, first requires students to develop a reasonable process route, including the car, milling, pliers, gouging and other types of work, through a process, from simple to complex processing of various parts. Qualified finished products make students feel a sense of accomplishment. In the practice of electronic electrician, each student is required to complete the installation of transformer, low-voltage distribution, relay control device, multimeter and TELEVISION 6 sets of internship projects. Remarkable results have been achieved in cultivating engineering practice consciousness.

2.1.2. Attach Great Importance to the Construction of Off-campus Practice Bases

To cultivate students' views on labor through working in enterprises corresponding to their majors, listening to lectures, visiting and investigating, etc. The school actively takes advantage of the Sino-German cooperation program and insists on the construction of off-campus internship base. The university has a stable number of off-campus practice units. Over the past few years, the university has expanded and adjusted its off-campus internship base through the education of industry, education and research. In line with the principle of "mutual benefit" and "complementary advantages", the university has not only continuously improved its off-campus internship base, but also turned it into a training and scientific research base for enterprises. Without the extensive and close contact and cooperation between the school and the enterprise, training excellent engineers is just empty words, and the enterprise's off-campus internship base is irreplaceable.

2.1.3. Combination of Practice and Theoretical Teaching

In the first semester, I will arrange theoretical teaching, mainly including continuous foreign language courses and courses closely related to production practice, such as gold metal technology for mechanical students and electronic circuits for electrical majors. This not only solves the problem of course connection before and after production practice, but also makes the arrangement of the first practice semester more compact and rich, which also plays a very good role in cultivating students' ability of combining theory with practice.
2.2. Implement Practical Project Teaching and Cultivate Application Ability

2.2.1. Strengthen the Cultivation of Experimental Ability

The construction of experimental teaching system implements PBL teaching mode: (1) Problem Based learning;(2) Process Based Learning;(3) Project based learning, through PBL experimental teaching, to achieve people-oriented and personalized education, let students "experience and feel"[4]. Taking problems as the entry point, it fully embodies the educational idea that innovation originates from problems and starts from practice. The implementation process of specific experimental teaching: First of all, the student experiment starts from simple and easy to learn, let the students write the experimental preview report; Secondly, students' experimental report is like a small paper, scientific principles, operation process, data analysis, experimental summary, very detailed. Moreover, in the experiment, the combination of students' experimental groups is very special. Students often work in groups of four and are not familiar with each other. After one experiment, the next experiment is a new combination. The experiment report was completed by four people except for the feelings of the experiment that each person had to write. This is very beneficial to the development of students' communication skills and teamwork spirit.

2.2.2. Pay Attention to the Connotation Construction of Practice Teaching

The construction and reform of innovative practice teaching system is based on experimental teaching content and students' acquisition of experimental skills. In the training system, we should strengthen the arrangement of the comprehensive, design and innovative special subject experiment and professional engineering practice teaching[5]. At the same time, vigorously promote the application of modern teaching means in practice teaching, with advanced teaching means to effectively serve the innovative practice teaching system. During the experiment, the teacher gives the assignment and requirements of the experiment, and the students are required to complete the experiment by themselves, including experiment plan, product design, experiment operation, data collection and result analysis. In this way, students' ability to analyze and solve practical problems is strengthened, so that outstanding students stand out.

2.3. Carry Out In-depth Exploration and Research Practice to Cultivate the Ability to Solve Practical Engineering Problems

2.3.1. Technical Practice Enhances Engineering Practice Ability

Technical practice is arranged in the seventh semester. Students are required to take part in technical and management work in industrial and mining enterprises and scientific research units as prospective engineers, so as to further broaden and deepen professional knowledge, cultivate independent working ability and produce technical achievements[6]. At the same time, in the production site to find suitable graduation project topics, and obtain the enterprise's demand for talent and employment information. Obviously, there are two clear and realistic standards for technical practice: one is whether it can solve production technical problems for the practice unit and bring back technical achievements; Can we find the practical application topic for the following graduation project? After more than ten years of unremitting efforts, remarkable results have achieved the expected goals and requirements. More than 90% of the students have obtained various technical achievements, such as special machine tool design, current product development, new process preparation, computer software development, etc. About 60% of the students from the actual production project graduation project topic selection has been recognized by the instructor.
2.3.2. Emphasize that the Graduation Project Comes from Engineering Practice

Over the years, we have been insisting on graduation project (thesis) facing the practical, facing the production in a hurry to solve the technical issues. 70% to 80% of the selected topics of engineering students' graduation projects (theses) come from practical problems that need to be solved urgently in production practice. The time limit for graduation project is about 6 months, which is mainly completed in combination with practical tasks in enterprises. In fact, many students usually takes more than six months or longer to complete the graduation design. Such as the university professor guide mechanical professional 2 students, graduation design topic selection from Taizhou Zhejiang pump industry, respectively, completed the QY90-4 axial flow submersible electric pump product development and 80 lb40-60 type screw pump design, before and after they spent nearly eight months. First to Taizhou nearly more than 20 pump enterprises of various types of pump structure, performance, use of the investigation, but also made a questionnaire survey. They collected about 30,000 pages of information from various sources. The finished graduation design has more than 200 pages, with a certain depth and reference value. In particular, the technical achievement of "3d solid modeling and unstructured grid division based on Pro/E pump runner" was approved by Taizhou Science and Technology Bureau.

2.3.3. Effect of Systematic Practice Teaching

Use students' own words in the practice summary report to illustrate their feelings about engineering practice in enterprises. "The technical internship not only enables me to have a firm grasp of theoretical knowledge and basic skills, but more importantly, it enables me to understand the engineering consciousness and practical ability of an engineer, so as to prepare for the technical work after graduation." In engineering practice has now ning and Zheng Bolei have experience greatly, with the students as students now ning said: "the project is my master professional knowledge and skills to better improve the practical ability, really use it to the learning effect, job, improve the team spirit at the same time." Tao Yining now works as an engineer in Zhejiang Luyuan Electric Vehicle Co., LTD., where the applied practice teaching of his Alma mater has been given full play. Now a business manager, Zheng Bolei works for Beijing Jin Tian 'an Electrical Equipment Co., LTD. Speaking of his Alma mater, what impressed him most was the school's cultivation of his practical ability.

3. Conclusion

To improve students' practical ability and overall quality as the core of "multi-level." The innovative practice teaching system of "through - through" plays an important role in training excellent engineers in system engineering. On the basis of summing up experience and investigating, we carry out the work of standardizing the practice teaching, which makes the practice teaching be institutionalized and standardized, and also makes this aspect of teaching reform achieve good results. Through the systematic innovative practice teaching can effectively improve students' practical engineering ability and create characteristics for training senior applied engineering technical personnel.

Acknowledgement

Fund project: 1. Zhejiang University Laboratory Research Project (No. : YB202047) 2. The second batch of Product-learning Cooperative education Project of Higher Education Department of the Ministry of Education in 2019 (No. : 201902154001)
About the author: Yu Caili, female, senior experimental teacher, master, research direction: Machinery manufacturing and automation, work unit: Zhejiang University of Science and Technology. Mailing address: 318 Liuhe Road, Hangzhou 310023.

References


