Reform and Practice of Experimental Teaching of Mechanical Engineering Specialty in Education of Outstanding Engineers

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ABSTRACT

In allusion to the cultivation of outstanding engineers in mechanical engineering specialty, the system reform of experimental teaching as the breakthrough point in the teaching practice of many years, from the experimental teaching content, methods, management and other aspects, the systematic discussion and research are explored to the "multilevel, progressive, integrated "experimental teaching system. Some effective new ideas and models make students enhance comprehensive quality at the same time, the engineering concept and quality has been comprehensively improved. It provides some reference role for the future work and practice teaching reform of other engineering colleges and universities.

KEYWORDS

Mechanical engineering; outstanding engineer; experimental teaching; reform.

INTRODUCTION

The characteristic specialty direction textile machinery and automation as the reform pilot in 2011, our school started the training program of outstanding engineer. After many years of teaching reform practice, through the construction of multi-level, progressive, integrated experimental teaching system, the update of experimental teaching contents, the reform of experimental teaching methods, the enhancement of information construction of the experimental teaching methods and management and other measures, exploration and practice of cultivating innovative talents are promoted. "Virtual-actual combination" experimental teaching system is formed. For the grade first-third students of outstanding engineers, the "progressive training", "project teaching" and "virtual-actual combination" and other new teaching methods are implemented, fourth grade students of outstanding engineers achieve curriculum design in the enterprise, graduation design "3+1" mode long-term mechanism make students innovative ability and engineering literacy greatly improved.

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However, under the new situation, there are ubiquitous in the higher engineering colleges and universities, the experimental teaching system does not match the teaching reform under the new situation, the logicality and coherence between the school and outside experimental teaching is poor; the "resources sharing" of experimental teaching in high school are not in place, "scale benefits" are poor; part of the curriculum design, graduation design topics are outmoded, they cannot advance with the times; there are insufficient experimental teaching resources, and the synchronization is very far from development of enterprise science and technology; young teachers attach importance to theory and underestimate engineering practice in teaching. Therefore, there is an urgent need to reform the experimental teaching.

**REFORM CONTENT**

**Multi-Level, Progressive, Integrated Experimental Teaching System**

Students do basic experiments and virtual simulation experiments in school; complete the internship, training, graduation design and other practice link in the enterprise. A new experimental teaching system is built in accordance with the hierarchical, sub-module, open experimental teaching model, as shown in Figure 1. It totals "specialized foundation experiment platform", "specialized integrated experiment platform", "interdisciplinary experiment platform", "innnovative research experiment platform" and "virtual simulation experiment platform" 5 experimental platform, 32 modules (including 10 virtual simulation module), it covers experimental project of mechanical engineering foundation, professional foundation and professional technology courses.

![Figure 1. Teaching platform of mechanical experiment.](image)
Machinery foundation and textile equipment design virtual simulation open experiment teaching platform with textile industry characteristics "virtual-actual combination" and "3 ability+4 level+10 modules" are established. The virtual simulation practice teaching is launched in 2013, and successfully declared Tianjin "machinery foundation and textile equipment design virtual simulation experiment teaching center" in 2015, and the virtual simulation experiment teaching center website are founded, website: http://jd.tjpu.owvlab.net; through the 10 modules of the virtual experiment teaching system, focus on improving the students' three abilities (practice, design, innovation), the mechanical talent training are met through the four levels (basic cognition, comprehensive training, professional design, innovative research). "Virtual design and simulation experiments of multi-function winding machine", "virtual assembly and mapping experiments of typical device opener complete machine" and other five experiments are developed.

Establish Outstanding Classes Complete the "3+1" Model Curriculum Design and Long-Term Mechanism of Graduation Design In the Enterprise

Since 2013, the "production, study and research cooperation" mechanism established in the early teaching reform, besides the latitude and longitude Co., Ltd. and several others jointly build teaching experiment base with our school in the early stage, in recent years, Changshu Yingyang Nonwoven Machinery Co., Ltd., Jiangsu Jinlong Technology Co., Ltd., Changzhou Tonghe Textile Machinery Co., Ltd. and other six cooperative units are newly founded, cooperative units total 16. As the "3+1" cultivation internship and training base of students in outstanding class, namely, three curriculum design ("mechanical manufacturing process and installation equipment", "design principle of textile machinery", "textile machinery transmission and control technology" course design) are carried out in the enterprise in the last year, a graduation design teaching experiment base. And new employment ways are established that student internship and employment link, when graduation "two-way choice" employment unit coordinated-process, namely, before the internship students understand the internship situation of enterprise, apply for employment units to practice. After 1 year enterprise internship, the employment agreement can be signed with the internship unit after "mutual recognition". Because this way recommends outstanding graduates to enterprises, wins the praise of enterprises, and achieves the win-win mechanism that school-enterprise cooperate to develop students. In addition, specific requirements documents that mechanical engineering college "outstanding class" students complete the internship, curriculum design, graduation design in the enterprise to are also developed. Grasp the monitoring process, stipulate students every day to write reading notes, fill out a weekly outstanding class" student graduation practice record table, this table is signed by the enterprise instructor, after printing and scanning, and send it to school instructors; also develop a "performance assessment" requirements is developed as well: the comprehensive assessment is accordance with percentage, the result of enterprise instructors account for 70% , the school teachers account for 30%, and other new relevant assessment and supervision mechanism.
Achieve Resources and Technology Sharing of Enterprise and University

The resources of scientific research, equipment and personnel and so on in cooperation units are made full use of to guide and train our students, the deficiency of this aspect in colleges and universities is made up for; regularly invite experts, professors and engineers from the industry to give lectures, and exchange professional technology with students, train students' engineering awareness. Meanwhile enterprises can use the advantages of scientific research in colleges and universities to make up for the lack of basic theory of enterprises, improve the quality of enterprise personnel, enhance the competitiveness of enterprises, enterprises and universities achieve resource sharing, mutual benefit and win-win situation.

Build Bridge for Young College Teachers in Colleges and Universities into the Enterprise

The young teachers and students in outstanding classes are selected to do practice in enterprise, and have more opportunities to machining shop, assembly shop, technology center and other departments to practice. It will be more convenient to contact with the production line, a good understanding of the level of technological development and project characteristics of enterprise, make up for lack of knowledge deficiency in engineering aspects, receive good results. Both scientific research ability is improved, understand the enterprise needs people with what kind of knowledge, and targeted teaching reforms are implemented.

APPLICATION RESULTS

Declare Tianjin "Machinery Foundation and Textile Equipment Design Virtual Simulation Experiment Teaching Center"

This specialty declares Tianjin “machinery foundation and textile equipment design virtual simulation experiment teaching center.” The machinery foundation and textile equipment design virtual simulation experiment teaching center of the Tianjin Polytechnic University is established, " machinery foundation and textile equipment design virtual simulation experiment teaching center platform" that jointly develop with enterprise rely on the campus network, the virtual experiment technology and network information technology are used to enhance the experiment and practice teaching, which is currently more advanced open virtual simulation experiment teaching platform in the use.

In order to better serve the students, the center set up machinery foundation and textile equipment design virtual simulation experiment teaching center website, where the information content can be dynamically released and managed by the Tianjin Polytechnic University, website: http://jd.tjpu.owvlab.net. Visitors can directly access the machinery foundation and textile equipment design open online virtual simulation experiment teaching platform through the center homepage, and carry out teaching activities, exchange learning and experimental experience.

Center achieve the "time, space, content," three opens, and then provide high-quality experimental teaching services for all colleges and students to the greatest extent. In time, 7 days a week, most of the experiment achieve 24 hours open; in
space, students can not only enter the relevant open laboratory for virtual experiments in the opening time, they can also access the online experimental system of virtual experiment with campus network to complete the experimental operation; students can not only operate in accordance with the experimental instructions that the teacher provides in the content, students can also design their own experimental projects, experimental process and complete experimental content that they are interested in. At present, in addition to teaching experiment of outstanding class students in mechanical engineering specialty, the industrial design department of mechanical engineering college, measurement and control department, mechanical design and manufacturing and automation six class students also use the part module of this platform, such as "continuous production process of textile products and equipment virtual simulation experiment module"," college students extracurricular scientific and technological innovation research practice virtual simulation experiment module"," scientific research transform virtual simulation experiment module"; etc.; because this site is open to the outside, we also recommend this website to the several colleges with textile background and internship enterprise, and receive good feedback.

**Strengthen the Internship and Practice Base Construction**

At present, the enterprises which has established this related specialty are 16, as the outstanding class students "3 +1" training practice base, namely teaching experiment practice base, students carry out curriculum design and graduation design in the enterprise in the last year. 11, 12 grade have graduated, 13 grade are doing "3 +1" practice in the enterprise, so that 100% fully cover graduates.

**Enhance the Engineering Practice Ability of Teachers and Students**

The students of the outstanding class won the third prize in "Knitting Collar Machine Design" of "Broad Digital Cups" graduation design competition in 2015, won the first prize in the 6th National College Students Mechanical Innovation Design Competition in 2014, won first prize the National Three-dimensional Digital Innovation Design Competition in 2012, 2013, 2014, 2015 for four consecutive years; 2 grand prize in 2013 National Three-dimensional Digital Innovation Design Competition (Tianjin zone). At present, 100% of the students in the outstanding class are involved in various provincial and national subject competitions, four teams report the innovation and entrepreneurship training program of the national grade college students, the students have written four papers, two papers are published in the international conference. Young teachers all take students into the enterprise, strengthen the production practice skills, enhance the production practice experience, and then teachers’ team who train engineering education talents are optimized.

**Strengthen the Joint Training of School and Enterprise**

The human resources and material resources of cooperative enterprises are fully excavated, such as Tianjin Hongda Textile Machinery Co., Ltd., Tianjin Textile Engineering Research Institute Co., Ltd., Jiangsu Jinlong Technology Co., Ltd., Qingdao Hongda Textile Machinery Co., Ltd. and other enterprises with cities industry advantages in and out of the city, "double tutor" system students practice training are implemented, give full play to students’ subjective initiative, improve the
efficiency and quality of practical teaching, and students have been highly praised by the employing unit.

Other Demonstration Effects

The successful reform experience of this specialty also play a demonstration effect for several other specialties in school of mechanical engineering-industrial design, measurement and control technology, mechanical design and manufacturing, and automation, good results are achieved after carrying out practice for several years; At present, this reform experience is being promoted at Tianjin Polytechnic University; meantime it also have certain demonstration effects for institutions, enterprises with the textile background.

The first meeting of textile equipment subcommittee of textile specialty teaching guidance committee of the Ministry of Education higher school" was held in Hangzhou Zhejiang Sci-tech University in June 20-24, 2014, the school leaders, teachers from Donghua University, Tianjin Polytechnic University, Zhejiang Sci-tech University, Suzhou University, Wuhan Textile University and other 16 colleges with textile background, exchange teaching experience in teaching work condition, personnel training, teacher team building, school-enterprise cooperation, outstanding engineers training mode, teaching materials construction and other aspects for textile and equipment specialty of different schools. The attendees agreed that the training methods of outstanding engineers that Tianjin Polytechnic University explore, especially what "3 +1" internship in enterprise do is the most unique, it is worth learning and promotion of the different schools.

CONCLUSION

By establishing "machinery foundation and textile equipment design virtual simulation open experiment teaching platform", outstanding classes complete the"3+1" model curriculum design and graduation design long-term mechanism in the enterprise, which are founded, new experimental teaching system and students’ practice modes are formed, those has played a good role to strengthen the practice teaching links, cultivate students' practical ability and adapt to social and economic development needs. After implementing a few years, the students who have been trained are obtained welcome and praise of enterprise. The results make the students enhance the overall quality, at the same time; engineering idea and quality have been comprehensively improved. A practical experience is proposed for the school-enterprise joint school and the establishment of win-win mechanism, with some promotion and application value.

REFERENCES


