2.1 获省部级教学成果奖复印件

目录

2-11. 2018年获天津市教学成果二等奖

天津市教育委员会文件

津教委〔2018〕15号

市教委关于公布第八届高等教育天津市级教学成果奖评审结果的通知

各高等学校：

根据国务院颁布的《教学成果奖励条例》，经第八届高等教育天津市级教学成果奖评审委员会评审、市教委审核批准，南开大学龚克等申报的《全面发展、主动成长——南开大学素质教育体系的探索与实践》等80项成果获第八届高等教育天津市级教学成果一等奖，南开大学段文斌等申报的《专业教育与全面发展融合并进的创新人才培养体系与实践》等120项成果获第八届高等教育天津市级教学成果二等奖（获奖项目名单见附件）。

开展高等教育教学成果奖励工作，是贯彻党的十九大精神，推动高等教育内涵式发展，建设人力资源强国，进一步加强教学

	施	风栋、李红凤	
32	工科专业卓越管理人才培养模式的探索与实践	齐庆祝、刘建凤、覃兰静、魏亚平、张录全、赵凯娜、罗艳、鲍丽达	天津工业大学
33	以纺织工业发展需求为导向的机械工程专业人才培养的改革与实践	杨建成、杨涛、温淑鸿、赵永立、李丹丹、董九志、袁汝旺、李新荣、王志芳、赵世海、王栋彦、赵镇宏、刘文吉、周国庆	天津工业大学
34	推动产业发展的非织造材料与工程专业建设的创新与实践	钱晓明、王闻宇、庄旭品、封严、刘亚、焦晓宁、程博闻、康卫民、邓辉	天津工业大学
35	创新实践教学体系与大学生创业生态环境建设的探索与实践研究	李铁、王赜、徐丕文、李飒、李文杰、李瑞、薛轶丹、王京跃	天津工业大学
36	基于OBE理念，依托纺织行业提高自动化专业人才培养质量的改革与实践	张牧、修春波、陈奕梅、师五喜、成怡、李红利、熊慧、郭宇、陈云军	天津工业大学
37	面向运行的飞行技术专业应用型人才培养体系设计与实践	庆锋、陈斌、王艳红、朱怡、杜醒、由扬、蒋洪旭、袁丁、李姝、周彦文、曹博书、刘佳颖、杨大鹏、高博	中国民航大学
38	基于应用型人才培养的油气储运工程专业实验教学体系改革研究与实践	崔艳雨、丁清苗、初晓、吴志梁、石博、文信剑、陈媛媛、杨广峰	中国民航大学、中国航空油料有限责任公司天津分公司
39	基于中外合作办学的实践教学体系研究与应用	苏志刚、陈亚军、王付胜、祝世兴、杨新渥、贾宝惠、倪育德、杨旭东、任光辉、	中国民航大学

中国纺织工业联合会教学成果奖

获奖证书

为表彰在纺织服装行业推动教学研究、深化教学改革、提高教学水平和教学质量等方面做出突出贡献的项目，特发此证书，以资鼓励。

成果名称： 依托数字化信息管理平台　推进卓越工程师培养的实验教学改革与实践

获奖等级： 三等奖

完成单位： 天津工业大学

主要完成人： 杨建成，赵永立，袁汝旺，李丹丹，董九志，周国庆，赵世海，李新荣

证书号：2017-GJ-111

中国纺织工业联合会

二〇一七年七月

中国纺织工业联合会教学成果奖

获奖证书

成果名称：立足纺织机械设计卓越工程师培养 创建校企合作育人平台的研究与实践

获奖等级：二等奖

完成单位：天津工业大学

主要完成人：杨建成、袁汝旺、赵永立、董九志、李丹丹

中国纺织工业联合会

二〇一五年十一月

证书号：2015-GJ-026

中国纺织工业联合会教学成果奖

获奖证书

成果名称：以“现代纺织装备技术研究中心”为主要载体，建立卓越工程师培养体系

获奖等级：三等奖

完成单位：天津工业大学

主要完成人：杨建成、袁汝旺、李新荣、冯志友、蒋秀明、李丹丹、刘薇、赵永立、董九志、赵世海、周国庆

中国纺织工业联合会

二〇一三年十月

证书号：2013-GJ-108

2.2 发表教改论文复印件

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2017 4th International Conference on Vehicle, Mechanical and Electrical Engineering (ICVMEE 2017)
ISBN: 978-1-60595-477-6

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

JIANCHENG YANG, ZHIFANG WANG, YONGLI ZHAO, DANDAN LI, JIUZHI DONG, TAO YANG, RUWANG YUAN, XINRONG LI and SHIHAI ZHAO

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", "innovative research experiment platform" and "virtual simulation experiment platform" 5 experimental platform, 32 modules (including 10 virtual simulation module), it covers experimental object of mechanical engineering foundation, professional foundation and professional technology courses.

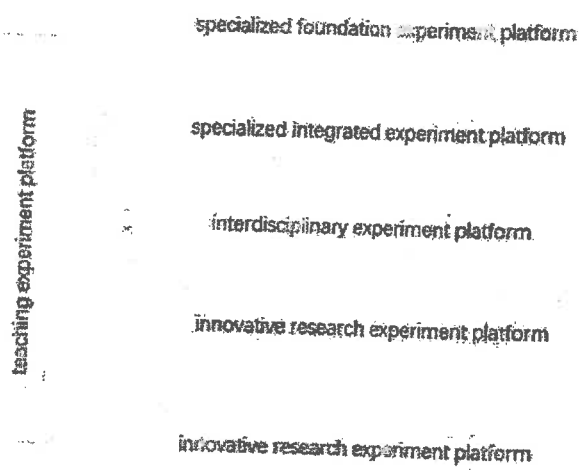

Figure 1. Teaching platform of mechanical experiment.

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.ovvlab.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, Changsha 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.tipu.cnvvlab.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 [illegible] and students to the greatest extent. In time, 7 days a week, most of the experiments 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 hat 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.

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ISSN 1671-024X
CN 12-1341/TS

天津工业大学学报

中文核心期刊 · 中国科技核心期刊 · RISTC科技核心期刊

Vol.36 No.2
2017 双月刊
TIANJIN GONGYE DAXUE XUEBAO

2.

天津工业大学学报

第36卷 增刊 2017年9月

期刊基本参数:CN 12-1341/TS * 1982 * b * A4 * 134 * zh * P * 8.00 * 200 * 48 * 2017-09

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【教育教学研究】

本期责任编辑:程晓英

第36卷 增刊
2017年9月

天津工业大学学报
JOURNAL OF TIANJIN POLYTECHNIC UNIVERSITY

Vol.36 Suppl.
September 2017

依托数字化信息管理平台深化卓越工程师培养的实验教学改革与实践

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董九志[1,2,3],李新荣[1,2,3],赵世海[1,2,3]

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摘 要:我校机械工程系特色专业方向"纺织机械及自动化"从2009年进行改革试点,2011年启动卓越工程师培养计划.近年,建立了"校企合作育人平台".随着教学改革的深入,一些校内、校外实验教学、管理不能满足教学需要.在企业做"3+1"实习的学生,校内导师、企业导师及学生不能实时在线的进行沟通,"过程管理"有欠缺,导致毕业设计质量有瑕疵等问题.因此,从2013年启动了虚拟仿真实践教学,建立了数字化信息管理平台,推进了实验教学改革,收到良好的效果.这些成果和经验可为其他工科类院校的实践教学改革提供一定的借鉴作用.

关键词:数字化信息管理;实验教学体系;虚拟仿真实验;卓越工程师

中图分类号:TN911.2 文献标志码:A 文章编号:1671-024X(2017)增刊-0019-03

提高人才培养质量必须适应新常态的社会需求,信息化给高等教育带来了前所未有的深刻革命[1].2011年我校以特色专业方向纺织机械及自动化为改革试点,启动卓越工程师培养计划.经过多年的教学改革实践,通过构建多层次、递进式、综合化实验教学体系,更新实验教学内容与改革实验教学方法,加强实验教学手段与管理的信息化建设等多项举措,促进了实践创新人才培养方面的探索与实践.然而,在新形势下,高等工科院校中普遍存在,实验教学体系与新形势下教学改革不相匹配,校内、校外实验教学、管理之间互补性差,实验教学"资源共享"不到位;在企业做"3+1"实习,学生、校内导师及企业导师不能实时在线的进行沟通,"过程管理"有欠缺;无法取得良好的教学效果.因此,从2013年启动了虚拟仿真实践教学,建立了数字化信息管理平台,2015年申报了天津市"机械基础及纺织装备设计虚拟仿真实验教学中心",深化了实验教学改革.

改革内容

(1)本着"能实不虚、虚实结合"的原则,构建了多层次、递进式、综合化实验教学体系.学生在校内进行基础实验、虚拟仿真实验,在企业完成实习、实训、毕业设计等实践环节.按照分层次、分模块的开放性实验教学模式构建了新的实验教学体系:"专业基础实验平台"、"专业综合实验平台"、"学科交叉实验平台"、"创新研究实验平台"和"虚拟仿真实验平台"共5个平台,32大模块(其中虚拟仿真模块10个).

(2)构建了具有纺织行业特色的"虚实结合"与"3能力+4层次+10模块"的机械基础及纺织装备设计虚拟仿真开放性实验教学平台.从2013年启动了虚拟仿真实践教学,2015年本专业申报了天津市"机械基础及纺织装备设计虚拟仿真实验教学中心",并建立了该虚拟仿真实验教学中心网站,网址:http://jd.tjpu.owvlab.net;通过10大模块的虚拟实验教学系统,重点提升学生的3种能力(实践、设计、创新),通过4个层次(基础认知、综合训练、专业设计、创新研究),满足机械类人才培养.开设了《高速、混相装置的设计虚拟仿真实验》等5个实验.

(3)建立了数字化信息管理平台,实现了"3+1"企业实习的学生,校内导师、企业导师在线实时互动,强化了"双导师"实践环节"同步"过程管理.从2015年

收稿日期:2017-04-25
基金项目:天津市普通高等学校本科教学质量与教学改革研究计划项目(B01-0802)
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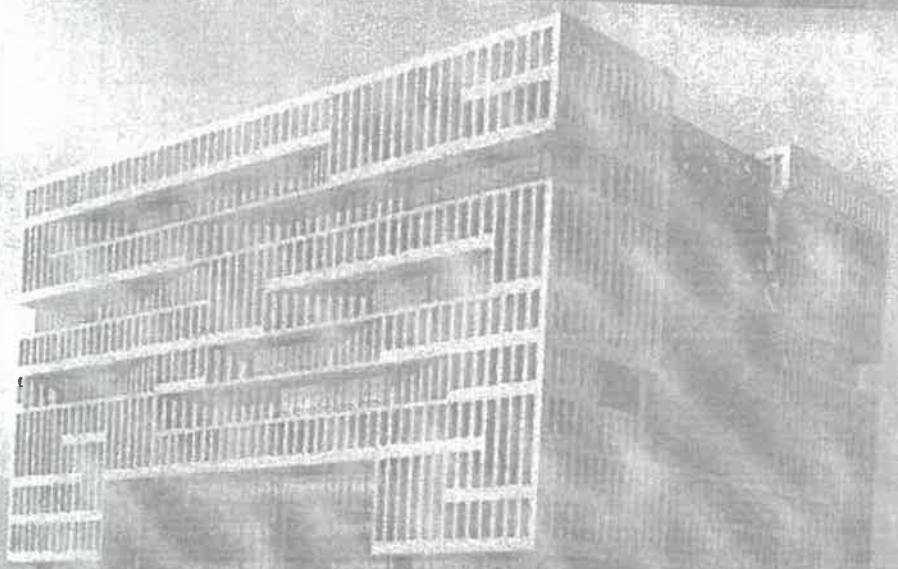
4th International Conference on Vehicle, Mechanical and Electrical Engineering (ICVMEE 2017)



Taiyuan, China

July 24-25, 2017

Editors

W.X. Liu, Z.G. Fang and G.T. Fei

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2017 4th International Conference on Vehicle, Mechanical and Electrical Engineering (ICVMEE 2017)
ISBN: 978-1-60595-477-6

Research on Virtual-Actual Combination Experimental Teaching Platform of Virtual Simulation Experiment Center Construction Practice—Taking Mechanical Foundation and Textile Equipment Experiment Center as an Example

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ABSTRACT

This article explains the significance of "virtual-actual combination" teaching mode of virtual simulation experiment, construction content of "virtual-actual combination" teaching platform on the basis of " virtual simulation experiment teaching center of machinery foundation and textile equipment design" construction work in school of mechanical engineering in Tianjin Polytechnic University, taking dynamic performance analysis simulation module of high speed and mixed-phase device as example, the implementation effect of "virtual-actual combination" is expounded, and the "virtual-actual combination" teaching platform construction of machinery foundation and textile equipment virtual simulation experiment center are prospected,.

KEYWORDS

Virtual simulation experiment; virtual-actual combination; teaching platform construction.

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THE SIGNIFICANCE OF "VIRTUAL-ACTUAL COMBINATION" TEACHING MODE IN VIRTUAL SIMULATION EXPERIMENT

The improvement of talent training quality must adapt to the social needs of new normal, information has brought unprecedented profound revolution to higher education [1], virtual simulation experiment classroom, Mooc, flipped classroom, micro classroom and other new things and ways with educational and teaching development appear. The teaching resources of virtual simulation experiment input the data or instruction to the simulation software or virtual scene through the virtual operation interface, through real-time simulation of computer and software, the simulation results is input to the display terminal or device or feed back to the users [2-3] The mechanical engineering specialty of Tianjin Polytechnic University has distinct textile machinery characteristics, because textile equipment with high speed, high precision, low torsion "two high and one low" characteristics, meanwhile textile equipment with large size, complex operation and a certain risk. The development of actual experimental teaching resources is costly and difficult; the virtual simulation experiment teaching platform can solve these problems well and benefit the students' innovation consciousness and ability cultivation [4].

High speed of textile machinery work, the experimental process is highly difficult and invisible

The textile equipment run with high-speed in the work, most of mechanism are closed, it is difficult to observe the internal composition of the machine and the movement of different mechanisms, it is not conducive for students to understand the basic working principle of mechanical equipment, the experimental process has a high degree of difficulty and invisible, it is unable to achieve a good teaching effect, the virtual experiment can evocatively, vividly and intuitively simulate those experiments that traditional experimental means are difficult to achieve. For example, high-speed looms reach 900 shuttles per min; each cycle includes five major sports. The center develops a high-speed loom conjugate cam mechanism rapier weft simulation experiment, through the weft motion of loom, weft insertion mechanism, and the mechanism diagram is drawn in accordance with the motion demonstration of virtual prototype, observe the changes of mechanism motion, and understand the design technology requirements of weft insertion mechanism of loom.

The complexity of textile machinery, the practice process with a higher difficulty

Textile machinery structure is complex, the factory site practice can only have intuitive feel for individual or some equipment, and it is difficult to understand the design process of overall equipment. Through the virtual experiment, motion process and working principle of textile machinery are reproduced; the students' perceptual knowledge is enhanced, and achieves twice the effect with half the effort. For example, the combing process in the textile production; and it is completed mainly by feeding, clamping, combing, extraction, cleaning and plodding and interoperable motion of other mechanisms. In a working cycle, the motion of main components of the combing machine include: combing cylinder, brush and other continuous rotary motion, the intermittent rotary motion of feed roller, detaching roller and detaching top roller and other parts, the swing of upper and lower clamp, top comb and so on. When

in on-the-spot teaching, due to security reasons, the machine cannot be opened; students cannot understand the motion of different mechanisms when the combing machine works, the teaching requirements cannot meet. Using the virtual assembly experiment, the motion and cooperation of combing machine in a working cycle are clearly shown in front of students, achieve "virtual assembly -> motion simulation -> equipment design", the learning enthusiasm and initiative of students are greatly stimulated, and the teaching quality are improved.

Textile machinery and equipment with high cost, high consumption, and the expansion of actual teaching resources are not accessible

Modern textile equipment develop to the high-speed, automation, intelligent direction, high integration, complex system, expensive equipment, electricity, liquid, gas and other resource consumption are big in the operation process of, post-maintenance costs are high, operation risk of some equipment is high. Due to limitation of funds and place, the number of actual teaching equipment is limited, which causes to students' participation is low or only watch demonstration experiment, students' practical ability training cannot meet, open, independent design, innovative experiments are difficult to carry out, so that students' practice ability is not strong, lack of innovation consciousness, cultivations of high-quality personnel are restricted..

The virtual simulation experiment teaching is used to achieve the experimental that the actual experimental teaching cannot reach. Through the application of the virtual simulation system, we can design the instrument to be used in the experiment by the three-dimensional modeling, so that students will have a preliminary understanding and appreciation for the equipment in upcoming experiment, more deepen the students' experimental impression, it is conducive to improve speed in the actual experiment to ensure the smooth progress of the experiment.

MACHINERY FOUNDATION AND TEXTILE EQUIPMENT VIRTUAL SIMULATION EXPERIMENT CENTER "VIRTUAL-ACTUAL COMBINATION" TEACHING PLATFORM CONSTRUCTION CONTENT

Traditional textile machinery experiment teaching can only use the demonstration mode. Machinery foundation and textile equipment virtual simulation experiment enter in line with "the actuality as the principal thing, virtual-actual combination, can actual not true" teaching mode, students first from the equipment design to process design and then to the application effect of virtual simulation, the equipment design parameters and processing technology parameters are optimized, which can greatly improve the success rate of the experiment, shorten the experimental time, it can enable students to get more training opportunities in the original experimental time, and enhance the effect of engineering training.

Focus on improving the students' three kinds of ability, through virtual experimental teaching platform with four levels and ten modules; talent training of understanding engineer in mechanical engineering and practice teaching tasks of five college students' competition basis are met. The cultivation of three abilities, practical ability, professional design ability, scientific and technological innovation

ability; four levels: basic cognitive level, comprehensive training level, professional design level, innovation research level; 10 modules are:

Interactive cognitive virtual simulation experimental modules of commonly used mechanical parts

Tangible showcase with a fixed position, it is not easy to dismantle and need regular maintenance and other defects. Therefore, the basic virtual experimental platform is established, simulate bolts, keys, cylindrical gears, bevel gears, worm gear, worm, belt wheel, axle, shaft fastening elements and rolling bearings 48 commonly used mechanical three-dimensional effect diagram.

Interactive cognitive virtual simulation experiment modules of special mechanism

The special mechanisms of mechanical specialty laboratory, display linkage mechanism, cam mechanism, gear transmission mechanism and other common mechanical mechanisms are included, and those provide for students to refer and make interactive experiments during the design and drawing.

Special parts of textile equipment design virtual simulation experiment module

The special parts library of textile equipment is established through the three-dimensional design development, special parts of virtual experiments are set up to meet the basic cognitive level and hands-on practice assembly capacity.

Mechanisms design and analyze virtual simulation experiment module

The virtual designs of the mechanism motion law; the virtual design of the mechanism type and the virtual coordination design are carried out through the three-dimensional design development, the organizational structures and scale parameters of motion characteristics and functional requirements are determined through the optimization design, kinematics and dynamic analysis of the mechanism.

Structural design and analyze virtual simulation experiment module

Structural design analysis uses Catia, Solidworks, Pro/E and other 3D software to design the structure of parts, the finite-element analysis software is used to calculate the strength and stiffness of parts, the structural dimensions of parts are determined, FATIGUE software is used to compute life analysis of parts in accordance with operating conditions, the students' structure design trainings are met.

Three-dimension design virtual stimulation module of typical textile equipment

Taking the practical textile machinery engineering case as the object, Adams, Ansys, Romax and other first-class professional engineering software are comprehensively applied to design structure of parts, and carry out mechanical system design and performance simulation analysis. Students can complete the all-around training of the software basis, integration and advanced applications, carry out the

system-level virtual simulation experiment for the engineering case, and lay the foundation for the digital design analysis of the complex product.

Virtual simulation experimental modules with high-speed, mixed-phase device design

The equipment at high speed in the textile equipment (such as rapier loom weft insertion, web forming machine, etc.), they are often the work process that air, fiber, machine and other couplings cooperate, they cannot be online experiments; this problem is well solved through virtual simulation experiments, so that the purpose of design optimization is achieved.

Continuous production processes of textile products and virtual simulation experiment module of equipment

The latest textile development frontier technologies are chosen as the research object, Verify the virtual design of the whole machine, with production training and practice, and provide support for the training plan of outstanding engineer; At the same time, this diversified practice teaching platform can also serve enterprises for new product research and development, trial-produce and experiment. The textile industry has played an important demonstration and radiation effect in the universities with textile background.

College students' extracurricular scientific and technological innovation and entrepreneurship study and practice virtual simulation experiment module

In recent years, based on students' graduation design, curriculum design, college students' innovative entrepreneurship program project, mechanical innovation design competition, the national 3D innovation design contest, robot dual meet and other excellent subjects, the integrated experiment platform of virtual simulation is designed cultivate students' comprehensive design and analysis ability, innovation ability, ability of solving complex problem, experimental analysis ability and practical ability..

Scientific research results transform virtual simulation experiment module

The academic advantages and industrial characteristics of college are made full use of, the sophisticated scientific research are transformed into the teaching case, show students through the form of virtual simulation, broaden their horizons, enhance their knowledge structure, cultivate the confidence to climb the scientific peak, and stimulate their scientific research innovation ability.

IMPLEMENTATION EFFECT AND PROSPECT OF "VIRTUAL-ACTUAL COMBINATION" OF MACHINERY FOUNDATION AND VIRTUAL SIMULATION EXPERIMENT CENTER OF TEXTILE EQUIPMENT

School of Mechanical Engineering was approved as training unit of outstanding engineers by the Ministry of Education in 2011, as an opportunity, experiment center School of Mechanical Engineering launched construction of virtual simulation

experiment center. According to the training objective of prerequisite, independent, assessable knowledge, ability and quality of undergraduates, based on the "can be real and not virtual, virtual-actual combination, the independent research and development as the principal thing, combination of independent research and development and introduction" principle, develop a number of virtual simulation experiments with professional characteristics and combined with the academic forefront and gradually constituted a system.

Simulation module example of dynamic performance analysis of high-speed and mixed-phase equipment

According to the high speed, light load and complex motion characteristics of textile machinery, the innovative design is carried out in structure of textile machinery by using the current design method theory and computer aided design analysis software, the virtual design system method of the textile machinery with mechanism modeling, motion simulation, dynamic analysis, structure and thermal analysis, optimization design and so on is formed; special loom (3D loom, heavy wide loom, new-type digital shuttleless loom, etc.) are made design and develop of complete machine as the research object..

The typical experiments of the module are: motion experiment of high-speed rapier loom and parameterized virtual design experiment of air-lay web duct, it is difficult to complete those by the physical experiment. Taking parameterized virtual design experiment of air-lay web duct as example, the air-lay web is one of the key processes that dry process non-woven create net combing, It manufactures the fiber raw materials through preparatory process into fibrous webs which are composed of single fibers for reinforced web-forming of subsequent process. This experimental equipment can achieve the continuous feeding and intermittent feeding of the fiber, and the fiber transport duct and the blown air flow can be adjusted, so that a variety of fibers can be done airflow web forming, fibers in the fiber web are mixed and disorderly arrangement, the tensile and anti-shearing performance of fiber web are improved. Duct parameter design is the key question to the web-forming quality, but it cannot be reflected in the actual experiment. Virtual simulation experiments can do three-dimension modeling and mesh generation based on Gambit software, through the Fluent finite element analysis software, standard k-ε two-equation turbulence model carries out numerical simulation and simulation analysis for the internal flow field of duct, The velocity distribution diagram (Figure 3.1, Figure 3.2) obtained by analysis and the pressure distribution diagram (Figure 3.3) show that the selection of different parameters of the duct is reasonable or not, the expanding structure is used in line with the law of air diffusion, and it is suitable for the uniform collecting cotton of cotton condenser.

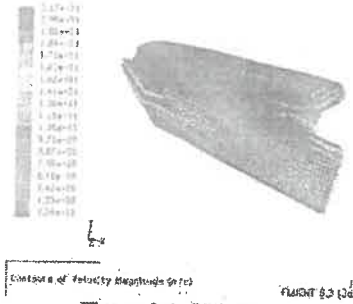

Figure 3.1. Velocity contour map.

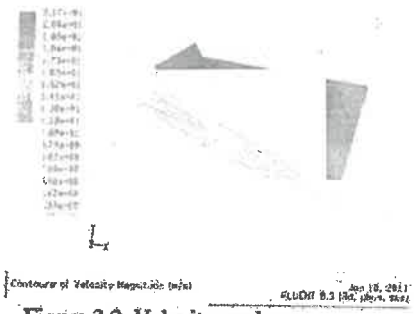

Figure 3.2. Velocity nephogram.

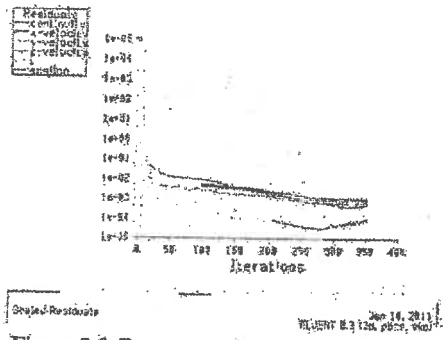

Figure 3.3. Pressure residual curve diagram.

respects

The center is approved as Tianjin municipal teaching demonstration center in 015, independently developed virtual simulation experiment teaching resources have een used in teaching, scientific research, production and other fields, the promotion fect is remarkable. Self-compiled " virtual experiment of typical textile machinery sign" experimental instruction book, task book, other auxiliary experimental aching materials and virtual experimental platform in some colleges and universities e promoted and used; through virtual experiments, the "comprehensive parameter st bench of rove flyer", "yarn winding law test bench", " self-parking device" and her equipment are independently developed, related technologies are used by textile achinery manufacturing enterprises and textile mills. 57 kinds of virtual simulation periment project have been developed successively; make students feel the most vid teaching effect. The teaching interactive platform of online courses is tablished, and used in experimental teaching, the application effect is good. The tual experiment teaching resources of independently developed simulation periment platform account for 50%, experimental teaching resources is rich.

With the expansion of the scale of the experimental center, its "resource sharing, ıle benefit" advantages have become increasingly obvious. the "National Machinery ıovation Competition (Tianjin Zone)" and "North China Robot Innovation mpetition" and other high-level college students science and technology mpetition have been taken in 2010, 2012, 2014, participate in the "National Three-nension Design Innovation Competition" annually since 2010, and obtain standing achievements of first prize in National 3D Innovation Design Competition e Finals. In addition, under the promotion of engineering education reform and standing engineer training plan, the experimental center has attracted many well-

known enterprises, new textile machinery design studio and other joint innovation laboratory, national training base have been established successively, and enterprise resources are made full use of to further broaden the channels of students' practical ability training.

CONCLUSION

In summary, limitations of the existence of virtual simulation experiment teaching should be recognized as well, scientific planning and overall arrangements are made, improvement of students' practice innovation and entrepreneurship ability as the fundamental starting point, the virtual experiment and real experiments integrate closely to enhance the entity experiment effects. The development of virtual simulation experiment teaching center should take actuality as the principal thing, supplemented by virtual reality, virtual-actual combination, can be actual and not virtual. The construction of virtual simulation experiment teaching center will further promote the integration and sharing of experimental teaching resources, and promote the experimental teaching reform in colleges and universities and the continuous improvement of teaching quality of higher education.

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2017

ISSN 1672-4305

第五届编辑委员会

机械基础及纺织装备设计虚拟仿真实验中心建设

杨建成[1,2,3]，杨 涛[1,2,3]，赵永立[1,2,3]，温淑鸿[1,2,3]，李丹丹[1,2,3]，刘文吉[1,2,3]
（天津工业大学 1. 机械工程学院；2. 天津市现代机电装备技术重点实验室；3. 机械基础及纺织装备设计虚拟仿真实验教学中心，天津 300387）

摘 要：天津工业大学机械基础及纺织装备设计虚拟仿真实验教学中心开展了高速度、高精度、低扭矩，体积大、操作复杂的纺织机械的虚拟仿真实验教学，建立了安全可靠、可视化、低消耗的虚拟仿真实验教学平台。中心充分利用学科优势和行业特色，将尖端的科研成果转化为教学案例，通过虚拟仿真的形式展现给学生，开拓其视野、提升其知识结构、激发其科研创新能力。同时，结合机械工程专业的特点和人才培养定位，通过高校与企业共建产学研的实践教学平台，构建了教学、科研与生产实习相衔接的实践教学体系。

关键词：机械基础；纺织装备设计；虚拟仿真；实验教学中心
中图分类号：G482 文献标识码：A doi:10.3969/j.issn.1672-4305.2017.04.051

Development of experimental center of virtual simulation of mechanical basis and textile equipment

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Abstract: The textile machinery of virtual simulation experiments with high speed, high precision, low torque, large volume and complex operation have been developed by the experimental teaching center of virtual simulation of mechanical basis and textile equipment design at Tianjin Polytechnic University, a safe, visualization, low consumption experimental teaching platform has been establishing. For the discipline advantage and industry characteristics, the sophisticated scientific research achievements have been converted into the teaching case, through the form of virtual simulation to students, which can develop their vision, improve their knowledge, cultivate their confidence, motivate their scientific research innovation ability. At the same time, according to the characteristics of the mechanical engineering and the orientation of talent cultivation, the practice teaching system of the teaching, scientific research and production practice has been built through the production teaching platform which has been built by the university and enterprise.

Key words: mechanical basis; textile equipment design; virtual simulation; experimental teaching center

近年来，国内外许多高校根据自身科研和教学的需求，开发了虚拟仿真实验项目，建立了虚拟实验室[1-2]。天津工业大学机械工程学院于2011年被教育部批准为卓越工程师培养单位，以此为契机，机械工程学院实验中心开展了虚拟仿真实验中心的建

通讯作者：李丹丹（1986-），女，江西丰城人，硕士，助教，主要研究方向为纺织机械设计及自动化等。

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Advances in Social Science, Education and Humanities Research

Volume 65

ATLANTIS PRESS *Advances in Social Science, Education and Humanities Research (ASSEHR), volume 65*
2016 International Conference on Education, Management Science and Economics (ICEMSE-16)

Research on Virtual Simulation Experiment Center Construction Practice and Resource Sharing Management Mechanism

—Taking Mechanical Foundation and Textile Equipment Experiment Center as an Example

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***Abstract*—In order to promote the opening and sharing of virtual simulation experiment teaching resources, this paper expatiates on the construction content and characteristics of virtual simulation experiment center of mechanical foundation and textile equipment based on the construction work of "virtual simulation experiment teaching center for mechanical foundation and textile equipment design" of school of mechanical engineering, Tianjin polytechnic university. The paper studies and proposes the sharing management mechanism of the resources of virtual simulation experiment center for mechanical foundation and textile equipment, and predicts the follow-up sharing management of the resources of virtual simulation experiment center for mechanical foundation and textile equipment.**

***Keywords*—mechanical foundation and textile equipment, virtual simulation experiment, sharing management mechanism**

I. Introduction

In order to carry out and implement the spirit of *Some Suggestions on Improving the Quality of Higher Education In a Comprehensive Way by Ministry of Education* (Professor of Engineering [2012] No.4), according to *Education Informatization Ten-year Development Plan* (2011-2020)", Ministry of Education has carried out the construction work of national virtual simulation experiment teaching center since 2013. The virtual simulation experiment teaching is the important content of higher education informatization construction and experimental teaching demonstration center construction, and the product of deep integration of subject major and information technology[1]. "Scientific planning, sharing of resources, highlight the key points, improve efficiency, sustainable development" is the guiding ideology of the construction of virtual simulation experiment teaching center[1,2]. Tianjin polytechnic university school of mechanical engineering was awarded the outstanding engineer training unit by the Ministry of Education in 2011. Taking this as an opportunity and relying on "mechanical engineering and automation" national-level features professional, Tianjin mechanical foundation experimental teaching demonstration center, engineering practice education center of "textile technology and equipment" and Tianjin "modern electromechanical equipment technology" key laboratory scientific research platform, school of mechanical engineering experimental center carries out the construction of virtual simulation experiment center, and develops a series of virtual simulation experiments with professional characteristics and combined with the frontier of the discipline, and gradually constitutes a system and establishes "virtual simulation experiment teaching center for mechanical foundation and textile equipment"[3-5].

II. Construction Content and Characteristics of Virtual Simulation Experiment Center of Mechanical Foundation and Textile Equipment

A. Construct Experiment Teaching Platform with Textile Industry Characteristics Which "Combines Virtuality and Reality"

The traditional experimental teaching of textile machinery can only use demo mode. In the experimental teaching mode of textile machinery of "reality-oriented, virtuality and reality combination, choose reality over virtuality", students go through the virtual simulation process of equipment design, process design and application effect to optimize the equipment design parameters and processing parameters, which improves the one-time success rate of experiment and shortens experimental time. It allows students to get more training opportunities within the original experimental time, enhancing the effect of engineering training.

Focus on improving the three abilities of students, and meet the need of mechanical engineering excellent engineer training teaching and practical tasks through the virtual experiment teaching platform of four levels and

ISSN 1671-024X
CN 12-1341/TS

天津工業大學学报

JOURNAL OF TIANJIN POLYTECHNIC UNIVERSITY

中文核心期刊·中国科技核心期刊·RSSEC核心期刊

第35卷 Vol.35
2016 增刊
TIANJIN GONGYE DAXUE XUEBAO

第35卷 增刊 天津工业大学学报 Vol.35 Suppl.
2016年9月 JOURNAL OF TIANJIN POLYTECHNIC UNIVERSITY September 2016

虚拟仿真技术在纺织机械实验教学中的应用

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摘 要:文中介绍了虚拟仿真技术在纺织机械实验教学中的应用,通过采用虚拟仿真实验,大大激发了学生学习的积极性和主动性,提高了教学质量.虚拟仿真技术的应用将对于纺织机械实验方式的改革,进而对纺织机械实验教学改革的一大新方向.

关键词:纺织机械;虚拟仿真;实验教学

中图分类号:TP391.9 文献标志码:A 文章编号:1671-024X(2016)增刊-0204-02

实验教学是理论教学的一种延续,是让学生对课堂上所学知识进行消化和吸收的过程[1-2].学生通过亲历实验过程,能够将所学知识化为实践技能.随着现代纺织装备向高速化、自动化、智能化方向发展,其集成度高、系统复杂,采用真实装备进行实验教学将导致不可及或高成本、高消耗,学生参与程度低或者只能观看一些演示实验,无法满足学生实际动手能力培养的需要.开放、自主设计、创新型实验更是难以开展.基于虚拟仿真技术的实验教学投资少、安全性高,可以设计极端条件下的运行实验,为实验教学提供了有力的支持[3-5].在此背景下,虚拟仿真技术应运而生.采用虚拟仿真实验教学,可以实现真实实验教学所不及的实验教学.通过虚拟仿真系统的应用,可以将实验中所要使用到的纺织机械中的机构通过三维建模设计出来,让学生对即将进行的实验中所要接触的机构有一个初步的了解和认识,这样更能加深学生对实验的印象,有利于在实际的实验中提高效率,确保实验的顺利进行.随着计算机和网络技术的不断发展,虚拟仿真技术日益成熟,使得借助虚拟仪器进行实验教学成为可能.虚拟仪器能将传统仪器的硬件功能软件化,这给实验教学带来了深刻的变化[6-8].

1 虚拟仿真技术在纺织机械实验教学中的必要性

实际中纺织设备高速运转,其中多数机构是封闭的,难以观察到机器的内部组成及各机构的运动,这无疑给实验实践教学带来了困难.学生难以理解设备的基本工作原理,使得实验过程具有较高难度和不可视性,缺乏学习兴趣,无法取得良好的教学效果.虚拟实验能形象、生动、直观地实现那些传统实验手段难以实现的实验.

同时纺织机械相对其他工程类机械而言结构复杂,且工厂现场的实习也只能对个别或某些装备有直观感受.短期实习难以跟踪整体装备的设计过程.通过虚拟装配实验,再现纺织机械运动过程和工作原理,有效增强了学生的感性认识,达到了事半功倍的效果.采用虚拟装配仿真实验,可以将各机构的运动与配合清晰地展现在学生面前,达到"虚拟装配—运动模拟—装备设计",大大激发了学生学习的积极性和主动性,提高了教学质量.

2 虚拟仿真技术的应用

目前,天津工业大学机械工程学院与北京润尼尔网络科技有限公合作,共同建设了虚拟仿真实验教学平台,合作研发具有扩展性、兼容性、前瞻性的管理和共享平台,高效管理计算机实验教学资源,实现校内外的实验教学资源共享,满足计算机虚拟仿真实验教学的需求;其次还共同开发虚拟仿真实验教学资源,北京润尼尔提供虚拟仿真开发技术和相应技术支持服务.与教师合作开发多功能卷绕机、粗纱锭翼综合参数测试装置、锭子振动测试仪、高速剑杆织机和气流成网机的虚拟仿真教学资源,下面以高速剑杆织机和气流成网机为例.

2.1 高速剑杆织机虚拟仿真实验

剑杆织机的运动包括开口机构运动、引纬运动、打

收稿日期:2016-03-20

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动、送经和卷取五大运动，五大运动以主轴为参
织物组织的不同按按周期配置．在现实实验中
将这五大机构的运动情况看清楚，同时五大机构
是如何配合的也难以看清楚，通过虚拟仿真实验
将织造工艺原理变得形象化、生动化，有助于学
复杂专业内容的理解和掌握．虚拟织造设备如图1
，优化了实验环境，可操作性强，能够较好的培养
的创新思维和自主设计开发能力．

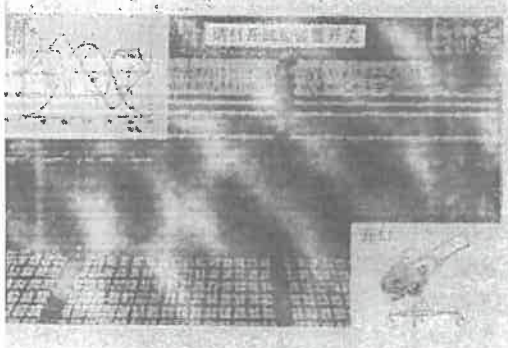

图1 高速剑杆织机运动仿真模块

高速剑杆织机仿真虚拟实验，主要包括以下内容：
1）通过织机引纬运动、引纬机构认知，根据虚拟
的运动演示绘制机构简图，观察机构运动的变化，
织机引纬机构的设计工艺要求．
2）通过高速织机打纬机构虚拟仿真实验，学生能
织机主轴到筘座的运动传递路线、机构形式；了解
动程、打纬角度、打纬运动时间、打纬静止时间等
参数的概念；了解打纬各机构参数对打纬工艺参
影响．
3）通过高速织机开口机构虚拟仿真实验，学生能
织机主轴到综丝的运动传递路线，织物组织运动
的输入方式，观察织物组织规律的变化对综丝运
律的影响；了解开口动程、综平时刻、综框位置等
工艺参数的调整方法．通过该虚拟仿真实验学生
虚拟现实织机开口机构，调节各工艺参数，观察
综位置运动规律的变化．

气流成网机虚拟仿真实验

气流成网风道参数化虚拟设计实验．气流成网是
纺织造成网中梳理是关键工序之一，它是把经过
工序的纤维原料加工成基本上由单纤维组成的
供后面工序的加固成网．该实验装置既可以实
续的连续喂入，又可以间歇喂入，并且纤维输送
喂入的气流流量可以调节，使其能对多种纤维
气流成网，纤网中的纤维呈无序杂乱排列，提高
网的各向抗拉和抗剪切性能．风道参数设计是
成网质量关键问题所在，而在现实实验中无法体现．

虚拟仿真实验可以基于 Gambit 软件对风道进行了三维建模及网格划分，通过 Fluent 有限元分析软件采用标准 $k-\varepsilon$ 二方程湍流模型对风道内部流场进行了数值模拟和仿真分析，通过分析得到的速度分布图如图 2 和图 3 所示，压力分布图如图 4 所示，表明风道各个参数的选取合理与否，采用渐扩结构符合气流扩散的规律，适于凝棉器均匀的集棉．

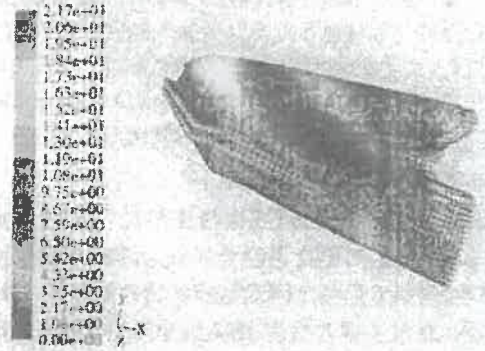

图2 速度等值线图

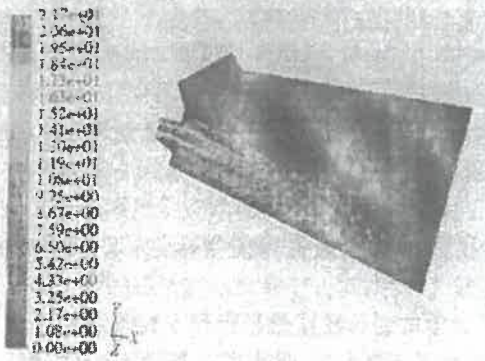

图3 速度云图

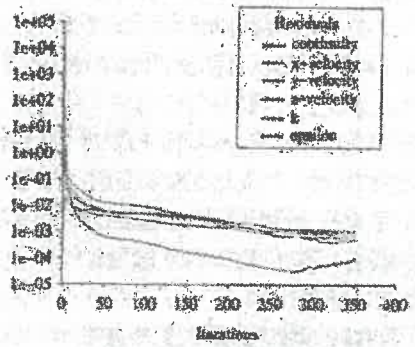

图4 压力残差曲线图

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筹划、实施都需要一定的场地，但并不是所有高校都可以提供场地支持，大部分都需要自行寻找场地，注册地点成为难题；其四，法律问题和财务问题往往是创业过程中最容易被忽视也是最需要专业支持的两个环节，既无这方面经验，也没有多余资金聘请专业人才[4].

2.3.2 盲目创业跟风创业，创业含金量较低

我国的创业教育和环境并不成熟，创业又是当下的热点，以致出现了盲目创业、创业人群呈现精英化等现象. 实际创业的不少，但大都缺少创新性，创业的"低门槛"导致了创业的"泛滥". 大部分创业项目都将短期利润回报定为主要目标，从市场中获得利润，而不是创造市场，缺少对技术领域的关注. 但从创业发达国家的经验来看，科技和技术创新才是促使社会进步的主要动力，相较于追求经济利益的重复性创业，创新才具有更高层次的意义和价值.

2.3.3 政策落实困难，细节问题待考虑

国家方面关于创业出台的政策能否有效落实到位仍待观察，对政策的宣传和解读也并不充分，导致政策与学生太远. 另外，学生在校期间进行创业时必须要考虑到学业问题，如何平衡好创业与学业间的问题也是需要高效思考，比如，是否允许休学创业、休学创业期间学生住宿问题、安全问题如何解决，以及是否能够降低对创业学生的学分要求等[4].

3 结 语

教育是社会进步的基石，未来很长一段时期创新创业都将是我国经济发展的催化剂和排头兵，创新创业教育是一项系统工程，需要国家、社会、高校和个人各方面共同投入和努力，才能在未来的国际竞争中不落人后，助力民族崛起.

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3 结 论

纺织机械的虚拟仿真实验并不是完全摒弃传统实验方法，而是要更好地丰富补充传统实验教学手段，进一步加深学生对实验原理、步骤、实验细节的掌握和理解，使教学更加生动形象，以此激发学生的学习兴趣和提高教学质量.

（1）通过采用虚拟仿真实验教学，可以将纺织机械机构装置中复杂的内部组成及运动配合再现，大大激发了学生学习的积极性和主动性，提高了教学质量.

（2）通过虚拟仿真系统的应用，可以将实验中所要使用到的纺织机械中的机构通过三维建模设计出来，让学生对实验中所要接触的机构有一个初步的了解和认识，更能加深学生对实验的印象，有利于在实际的实验中提高效率，确保实验的顺利进行.

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天津工业大学学报
双月刊,1982年创刊
第35卷 增刊
2016年9月30日出版

主管单位 天津市教育委员会
主办单位 天津工业大学
编辑出版 天津工业大学学报编辑部
地址 天津市西青区宾水西道399号
邮编 300387 电话 022-83955151
主 编 杨庆新
副主编 高崇文
数字出版单位 《中国学术期刊(光盘版)》电子杂志社
出版网站 中国知网
网 址 www.cnki.net
印 刷 天津中铁传媒有限公司
国内发行 天津市邮政局(邮发代号6—164)
国外发行 中国出版对外贸易总公司(DK 12104)
北京市朝阳区安华里504号(邮编 100011)

Journal of Tianjin Polytechnic Universit
Bimonthly, Started in 1982
Vol.35 Suppl.
September 30, 2016

Managed by: Tianjin Board of Education
Sponsored by: Tianjin Polytechnic University
Edited by: Editorial Board of Journal of Tianjin Polytechnic University
Address: 399 Binshuixi Road, Xiqing District, Tianjin, China
Postcode: 300387
Telephone: (022)83955151
Chief Editor: YANG Qing-xin
Associate Editor: GAO Zong-wen
Printed by: Tianjin CRM Printing Co. Ltd.
Domestic Distribution: Tianjin Post Bureau
E-mail: sjpuxb@tjpu.edu.cn

中国标准连续出版物号: ISSN 1671-024X / CN 12-1341/TS
天津市报刊增刊备案号:1213412016060
国内定价:8元/期

(1)

ISSN 1671-024X
CN 12-1341/TS

天津工業大學学报

JOURNAL OF TIANJIN POLYTECHNIC UNIVERSITY

中文核心期刊·中国科技核心期刊·RSSEC核心期刊

第35卷 Vol.35
2016 增刊

TIANJIN GONGYE DAXUE XUEBAO

7.

第35卷 增刊
2016年9月

天津工业大学学报
JOURNAL OF TIANJIN POLYTECHNIC UNIVERSITY

Vol.35 Suppl.
September 2016

虚拟仿真技术在纱线卷绕机实验教学中的应用

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摘 要:重点介绍了虚拟仿真技术在纱线卷绕机实验教学中的应用,通过采用虚拟仿真实验,解决了传统实验成本高、场地占用面积大、学生参与程度低等问题,大大激发了学生学习的积极性和主动性,提高了教学质量;虚拟仿真技术将成为实验教学改革的一个新方向.

关键词:纱线卷绕机;虚拟仿真;实验教学

中图分类号:TP391.9;G642 文献标志码:A 文章编号:1671-024X(2016)增刊-0182-02

随着现代纺织装备向高速化、自动化、智能化方向发展,其集成度高、系统复杂,采用真实装备进行实验教学存在如下问题:装备价格昂贵,前期投入大,运行过程中电、液、气等资源消耗大,设备后期维护成本高,有些设备类型风险高,受资金、场地的限制,装备台套数有限,导致学生参与程度低或者只能观看一些演示实验,无法满足学生实际动手能力培养的需要,开放、自主设计、创新型实验更是难以开展.然而虚拟实验具有成本低、效率高,可扩展性强、操作安全,高度开放和资源共享等特点[1-2].传统的实验教学有的只能采用演示模式,在"以实为主,虚实结合,能实则不虚"的实验教学模式下,学生先经过由装备设计到工艺设计再到应用效果的虚拟仿真,使装备设计参数和加工工艺参数得到优化,可大大提高试验的一次成功率,缩短实验时间,在原有实验时间内可使学生获得更多的训练机会,提升了工程训练的效果.当然,开设虚拟仿真实验,并不是完全丢弃传统实验方法,而是要更好地丰富补充传统实验教学手段.同时虚拟仿真技术应用到实验教学中将大大提高学生的积极性和主动性,提高教学质量.虚拟仿真实验教学有利于培养学生自我训练及创新意识,实现实验教学中虚实互补,因而成为目前实验室建设的一个重要发展方向[3-4].

1 虚拟仿真技术在纱线卷绕机实验教学中的必要性

纱线卷绕机卷绕形式多样,为了让各种卷绕形式一一展现给学生们,必将受资金、场地的限制,装备台套数有限,导致学生参与程度低或者只能观看一些演示实验,无法满足学生实际动手能力培养的需要,开放、自主设计、创新型实验更是难以开展.在此背景下,采用虚拟仿真实验教学,可以将实验中所要使用到的卷绕形式通过三维建模设计出来,让学生对即将进行的实验中所要接触的卷绕形式有一个初步的了解和认识,同时也能在机器上更换不同的卷绕形式实现不同形式的卷装,这样更能加深学生对实验的印象,有利于在实际的实验中提高效率,确保实验顺利进行.

利用网络化虚拟仿真实验平台以及开放实验室资源,提供一个全开放的自主学习的实验教学环境.通过课外创新实践项目立项并取得相应学分,鼓励学生积极参加课外创新设计学习,参加老师的科研项目,提高学生创新实践能力和培养科学研究能力,同时也可以为学生参加创新设计大赛提供相应的软硬件支持.通过公共基础、专业基础和专业技术实验教学、课外实践和科技创新活动整个完整过程的实验教学,使学生从入学到毕业各个阶段都能得到严格、良好的实践训练.同时,根据专业类型和学生的需求设置基本型实验、提高型实验和科技创新实践活动,实验教学中把研究型教学思想贯穿始终,使学生获得创新意识和工程实践能力的培养.

2 虚拟仿真技术的应用

纱线的卷绕主要是为便于制品(包括半制品)的

收稿日期:2016-03-02

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和运输，便于喂给下道工序进行加工处理。因此把这些制品按一定规律绕成具有一定紧密度的形式。一般纱线卷绕，为了使层次分清，都是按一螺旋线式绕成筒纱卷装。这就要求卷绕运动必须转运动和往复运动两种复合而成。由于复合作纱线按螺旋线分布在纱层面上，层层叠加，直至绕满，形成一个端面有规律的卷装。如图1

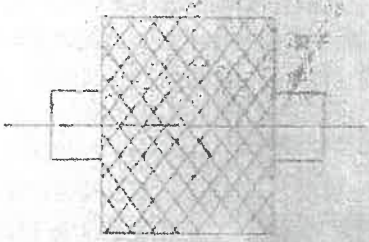

图1 直边卷绕

图1示纱线在圆形纱筒上形成螺旋卷绕时的运解——圆形纱筒的单向旋转运动及纱线沿与纱线平行直线的往复移动。这就需要两个执行构件生上述运动，一个构件是装卡圆形纱筒，并带动向转动的锭子，另一个构件是夹持纱线并带动其直线运动的导纱器。

纱线卷绕机虚拟样机如图2和图3所示。

图2 卷绕机虚拟样机

图3 卷绕机导丝机构虚拟样机

图2、图3中的实验纱筒的转动采用定子变速驱纱运动采用丝杠螺旋副传动(行程、速度均可通过鼠标左键可以控制视角旋转，中键滚轮拉远/视角，通过点击右上角图片来切换视角，便于观操作。通过设备上的按钮，控制设备工作，绿色按钮启动卷绕机，黄色点动，红色停止，另外还设有急停按钮，切断主电源，调速按钮可改变卷绕速度，也可以通过触摸屏设定相应的参数，如卷绕类型、卷绕速度、卷绕比、导程等，参数设定完后试运行，观察纱线卷绕情况。

该样机的纱线卷绕机采用模块式组合，选用不同的模块可完成不同的功能，可分别选用定子和圆柱凸轮、定子和丝杠组合、摩擦辊和圆柱凸轮、摩擦辊和丝杠四种组合实现等升角和等螺距卷绕。在实验过程中通过更换卷绕机构，可以观察到不同的卷绕情况。

3 结 论

纱线卷绕机的虚拟仿真实验并不是完全丢弃传统实验方法，而是要更好地丰富补充传统实验教学手段，进一步加深学生对实验原理、步骤、实验细节的掌握和理解，使教学更加生动形象，以此激发学生的学习兴趣和提高教学质量。此外，虚拟仿真实验平台使学生在课前起到预习实验的效果，增强实际实验学习的熟练程度，课后也能对实验做到反复练习，再现实验情境。

(1) 通过采用虚拟仿真实验教学，可以实现模块化实验教学，在一台机器上更换模块实现不同形式的卷绕，让学生对实验中所要接触的卷绕机构有一个初步的了解和认识，更能加深学生对实验的印象，有利于在实际的实验中提高效率，确保实验的顺利进行。

(2) 通过虚拟仿真系统的应用，可以实现卷绕机构的拆装，提高了学生的动手能力，大大激发了学生学习的积极性和主动性，提高了教学质量。

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本刊为

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天津工业大学学报
双月刊,1982年创刊
第35卷 增刊
2016年9月30日出版

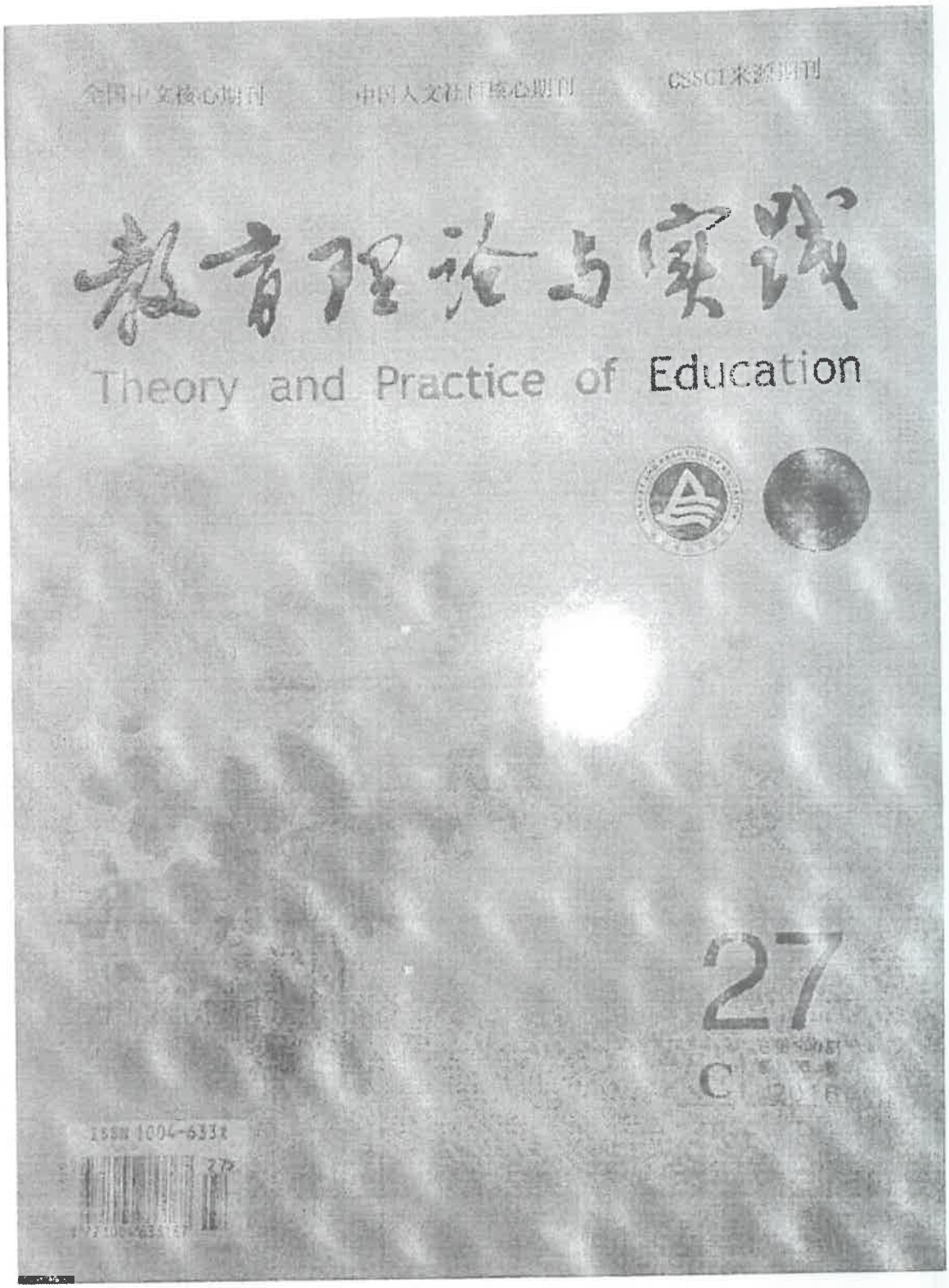
主管单位 天津市教育委员会
主办单位 天津工业大学
编辑出版 天津工业大学学报编辑部
地址 天津市西青区宾水西道399号
邮编 300387 电话 022-83955151
主编 杨庆新
副主编 曹宗文
数字出版单位 《中国学术期刊(光盘版)》电子杂志社
出版网站 中国知网
网址 www.cnki.net
印刷 天津中铁物资印业有限公司
国内发行 天津市邮政局 (邮发代号 6—164)
国外发行 中国出版对外贸易总公司 (BM 12104)
北京市朝阳区安华里 504 号 (邮编 100011)

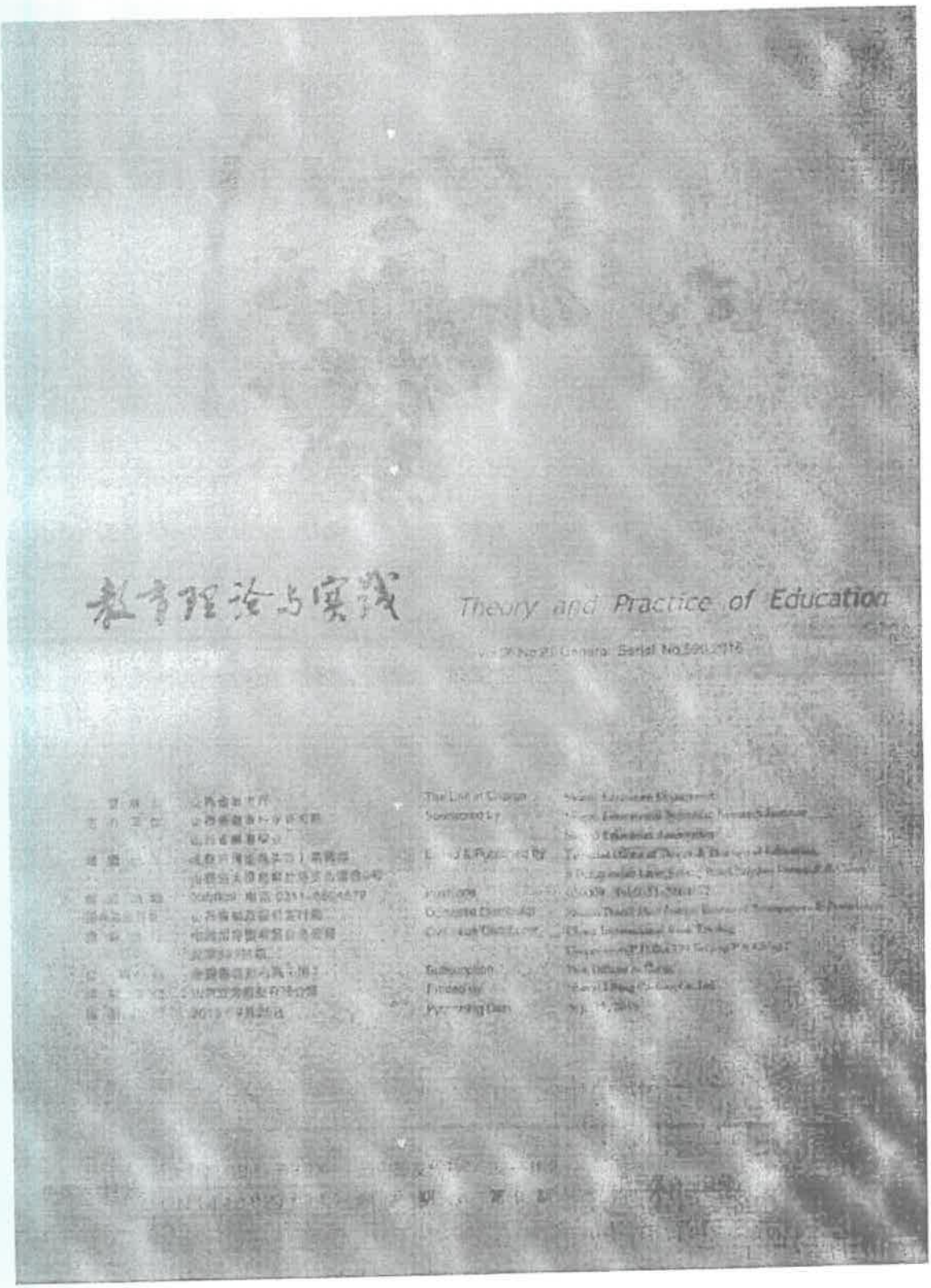
Journal of Tianjin Polytechnic Universit
Bimonthly, Started in 1962
Vol.35 Suppl.
September 30, 2016

Managed by: Tianjin Board of Education
Sponsored by: Tianjin Polytechnic University
Edited by: Editorial Board of Journal of Tianjin Polytechnic University
Address: 399 Binshuixi Road, Xiqing District, Tianjin, China
Postcode: 300387
Telephone: (022)83955151
Chief Editor: YANG Qing-xin
Associate Editor: CAO Zong-wen
Printed by: Tianjin CRM Printing Co. Ltd.
Domestic Distribution: Tianjin Post Bureau
E-mail: tjpuxb@tjpu.edu.cn

中国标准连续出版物号: ISSN 1671-024X / CN 12-1341/TS

天津市报刊增刊备案号:12134120160
国内定价:8 元/期


全国中文核心期刊
中国人文社科核心期刊
CSSCI来源期刊
教育理论与实践
Theory and Practice of Education
27
ISSN 1004-633X


教育理论与实践
Theory and Practice of Education

教育理论与实践

Theory and Practice of Education

第36卷(2016年)

第21期(总第590期)

1981年创刊 1985年公开发行

紧急通知

[illegible]

目 录

高等教育

职业成人教育

思想政治教育

师资建设

高教和职成教教学研究

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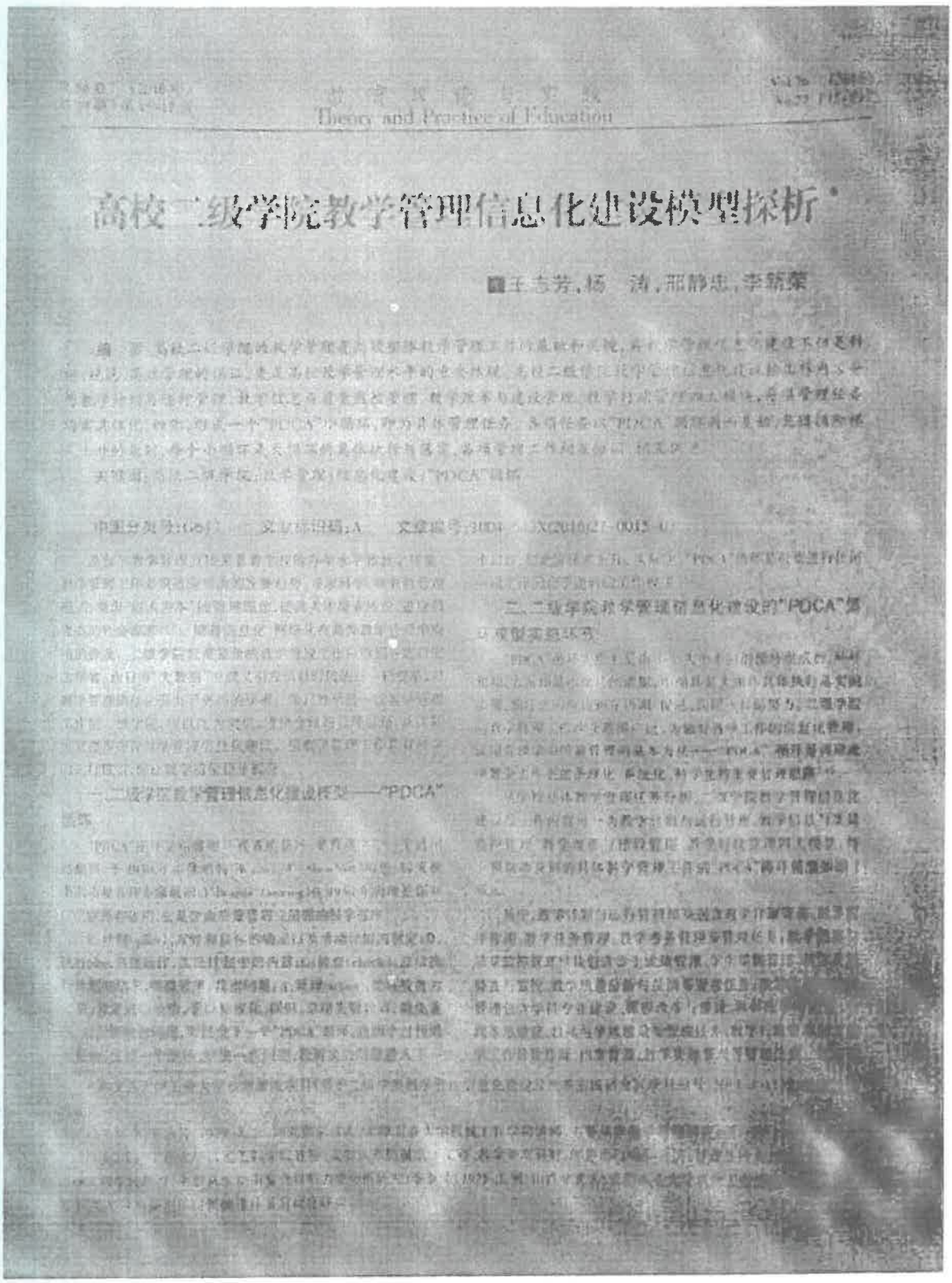


Theory and Practice of Education

高校二级学院教学管理信息化建设模型探析*

■王志芳，杨　涛，邢静忠，李新荣

ISSN 1001-7445
CODEN GDXZEB

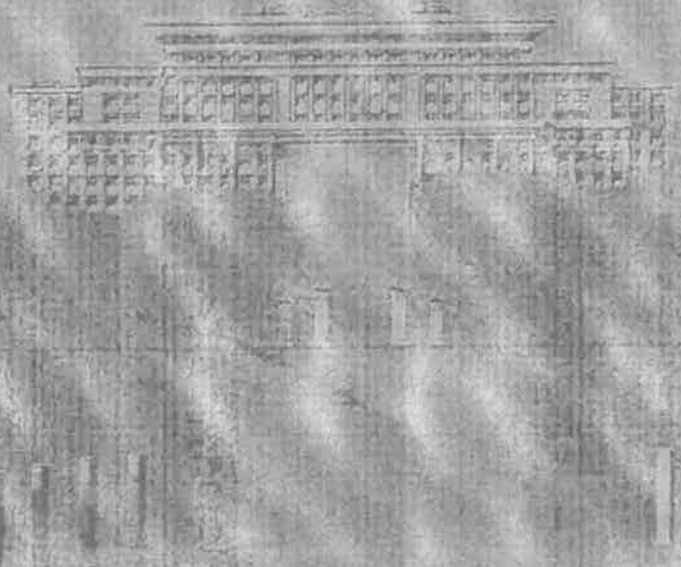
■ 中文核心期刊 ■ 中国科技核心期刊（中国科技论文统计源期刊）

广西大学学报

自然科学版

JOURNAL OF GUANGXI UNIVERSITY

NATURAL SCIENCE EDITION



2015
第40卷 增刊2
Vol.40 Sup.2

广西大学学报(自然科学版)
Journal of Guangxi University(Nat Sci Ed)
Vol. 40 Sup. 2
July 2015

机械原理、机械设计课程案例库建设及教学应用探讨

赵镇宏,杨世明,高淑英

(天津工业大学 机械工程学院,300387)

[illegible]机械设计课程特点,以"设计为主线,加强工程实践能力"为主导思想,进行案例库的建[illegible]设计开始到最后产品,概括和辐射诸多理论知识,将机械原理与机械设计教学内容及前[illegible]代部机的内容起来。根据专业特色寻找案例,塑造学生严谨的思维方法和开阔的应用开发能力,使学生[illegible]和能[illegible]到提高。

关键词:机械设计;案例库;创新
文献标识码:A 文章编号:1001-7445(2015)增2-0131-03

Study the Construction of Case Library and the Case Teaching

ZHAO ZHEN-hong, YANG SHI-ming, GAO SHU-ying
(School of Mechanical Engineering, Tianjin Polytechnic University, Tianjin 300387, China)

Abstract: According to the characteristics of theory of machines and mechanisms and design of machinery, "As design to the main line, for strengthen the ability of engineering practice" as the guiding ideology to conducted a case library. Project design from the beginning to the final product, Generalized and radiated many theoretical knowledge, making theory of machines and mechanisms and design of machinery to combine organic content. According to professional characteristics looking case, Shaping student critical thinking and open application development capabilities, improve students' creative quality and competence.

Key words: theory of machines and mechanisms ; design of machinery; case library; innovative

前 言

机械原理和机械设计是本科机械类专业教学计划中的两门必修的技术基础课。主要研究各种机械[illegible]般共性问题,学生通过课程的学习,掌握机构学和机器动力学的基本理论、基本知识和基本技能,并[illegible]具有拟定机械运动方案、分析和设计机构的能力,培养学生应用机械设计理论和方法从事机械设备[illegible]设计、使用和维护的能力,在培养高级工程技术人才的全局中,具有增强学生对机械技术工作的适应[illegible]力,特别是培养学生综合应用所学知识进行机械设备的开发和创新的能力[1-2]。

设计是工程实践的一个普遍的组成要素,教科书里习惯地要求学生用事先精心设置好的问题来阐[illegible]述,即"已知A、B、C、D,求E"。但现实的工程问题几乎从不是这种结构式问题[3]。课程的学习要求学

收稿日期:2015-06-26;修订日期:2015-07-06
通讯作者:赵镇宏(1967-),女,山东海阳人,天津工业大学副教授,博士;E-mail:zhenhong-zhao@sohu.com。

第34卷 (2014年)
第36期 第13-14页

教育理论与实践
Theory and Practice of Education

Vol. 34 (2014)
No.36 P13-P14

工程类专业学生创新能力培养体系的构建

李新荣，蒋秀明，杨建成，王晓维

摘 要：天津工业大学纺织机械教研室通过采用“课程需求化”、“导师精英化”、“实践企业化”、“关系家庭化”、“选题实用化”、“工作实践化”、“学习交流化”等方法，建立了纺织机械设计专业学生创新能力培养体系。该创新能力培养体系弥补了传统人才培养体系对工程类学生创新能力培养的不足，提高了我国纺织机械设计专业学生的培养质量。

关键词：工程类专业；学生；创新能力；培养体系

中图分类号：G645 文献标识码：A 文章编号：1004-633X(2014)36-0013-02

卓越工程师教育培养计划的人才培养目标为，“面向工业界、面向世界、面向未来，培养造就一大批创新能力强、适应经济社会发展需要的高质量工程技术人才”[1]。天津工业大学一直致力于校企合作、产学研结合的创新培养体系的探索，其中纺织机械专业是学校的特色专业，是天津工业大学“卓越计划”重要试点专业。纺织机械设计专业学生创新能力培养体系以新成立的“天津工业大学先进纺织装备技术研究中心”为载体，以实施“卓越工程师培养计划”为契机，采用“课程需求化”、“导师精英化”、“实践企业化”、“关系家庭化”、“选题实用化”、“工作实践化”、“学习交流化”等方法，培养具有扎实的机械基础及全面的纺织工艺知识，能综合应用机、电、光、仪完成纺织机械设备研究与开发的卓越工程师。天津工业大学机械工程学院纺织机械教研室通过改革专业课程设置、加强教师队伍建设、促进师生交流、增加校企联系合作等，多角度、多层次完善“卓越工程师”的创新能力培养计划。

一、课程需求化

课程教学内容和教学环节是工程类专业学生培养的基本要素，是培养出符合标准的工程人才的关键[2]。当前，我国的工程技术人才主要由高校培养，缺少企业的参与，大部分课程为理论课程，实践课程的比例偏小[3]，导致学生理论知识较强，动手能力较弱，不能符合企业的需求。因此，本教研室通过“天津工业大学先进纺织装备技术研究中心”的运作，发挥其纽带作用，实现高校师生与企业的零距离接触，同时，学校也可以及时了解企业需求、调整专业培养方案和课程设置、更新教学内容，提高学生的创新能力。纺织机械教研室在原有课程设置的基础上增加了“专家讲座”课程，国内外专家通过讲座将最新的、企业急需要的知识传达给学生，增加学生对纺织行业、机械专业的认知，最终达到“课程需求化”。

二、导师精英化

提高学生的工程实践能力，首先要提高教师的工程实践能力[4]。当前，很多高校教师具有深厚的理论知识，但是缺乏实践经验，不能灵活地把理论知识和实践相结合，导致学生的理论知识与实践能力之间出现了断层。纺织机械设计专业学生创新能力培养体系实验班采用“双导师”培养模式。“双导师”是指由校内导师与校外导师共同授课与指导的培养模式，其中，校内导师由具有丰富教学经验及专业理论知识的高校教师组成，校外导师由具有高级职称及丰富工程经验的企业工程技术人员组成。学生在企业与高校“双导师”的共同指导下完成学习任务，从而提高大学生的创新能力。纺织机械教研室通过培养年轻教师和外聘行业内的专业技术人员，以及培养和引进中年轻教师，加强导师队伍建设，通过加强师资力量实现“导师精英化”。

三、关系家庭化

当前，高校师生关系还存在很多问题，学生对师生关系的满意度不高，师生之间仅限于“教育者与被教育者”的关系，师生交往的时间和机会较少，直接影响了教学的效果，阻碍了卓越工程师教育培养计划的进行。因此，教研室从高校引进了一批具有工作经验的硕士和博士，从科研院所和机械企业引进了一批理论素质较高、又有实践经验的工程技术人员担任导师，并制定了专门的交流制度，从时间上增加了导师与学生的交往，从学习、生活等方面对学生进行指导，使学生和教师的关系家庭化。“导师

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学生交流制度"从时间和效果上保证了学生和导师的充分交流，即"关系家庭化"。

四、实践企业化

实践是应用知识和检验知识的重要环节。通过企业实践，学生可以将本课程体系中的相关知识融会贯通，用于解决企业的实际问题，并通过实际操作找到书本知识与实际工程实践的结合点。实施创新能力培养，必须选择行业内有影响力的大、中型企业作为合作对象，联合培养卓越工程技术人才，并在合作企业建立工程实践教育中心。通过"天津工业大学先进纺织装备技术研究中心"的纽带作用，学校先后与青岛宏大、天津宏大、经纬纺机榆次分公司、福建鑫华等企业达成联合培养协议，充分借助合作单位在科研、设备、人员等方面的优势资源，指导和培训高校学生。同时，学校加强了企业与大学的联系，企业可以借助高校的科研优势，弥补企业基础研发能力的欠缺，从而提高企业人员素质，增强企业竞争能力，实现企业与高校的资源共享。

五、选题实用化

工程类专业学生的课程设计与毕业设计是学生综合应用所学知识、培养工程实践能力的主要环节。该培养体系结合企业实践，将工程类专业学生的课程设计与毕业设计选题放到企业，并结合企业的实际需求，根据所学知识体系及工程类专业学生的培养要求进行选题。课程设计与毕业设计的题目来自企业，具有实用性、工程性，既满足了企业的实际需要，又培养了学生的工程实践能力，同时让学生了解和掌握企业的规章制度，为学生毕业进入企业打下坚实的基础。

六、工作实践化

学校调整课程，将课程设计、毕业设计集中安排在第四学年。学校在学生实践的基础上，联系行业内的国内外知名企业，结合学生的生源、就业等问题，并经过企业与学生的双向选择，让学生去企业顶岗实习。企业按照新就业学生的要求进行人才培养，结合企业的实际需要，引导学生进行选题，学生在企业及学校导师的共同辅导下完成毕业设计，解决了企业的实际困难，实现了学生工作的实践化。工作实践化可以让学生提前了解企业，认识自身的不足，树立正确的学习和工作目标。

七、学习交流化

要保证创新能力培养体系的前沿性，必须充分了解行业的发展动态，鼓励行业企业的优秀人才承担教学任务。在创新能力培养体系实施的过程中，要聘用具有工程实践经验的企业兼职教师，要求其同步更新专业知识，把最新的知识补充到教学内容之中。根据纺织机械专业学生创新能力培养体系的要求，天津工业大学制定了"公开课与讲座"时间表，请行业内的专家、教授、工程技术人员来学校讲课，与学生进行专业技术交流，加强学生专业知识的学习，保证了"学习交流化"。

另外，学校还采取相应的激励措施促进创新能力培养体系的实施，如为实验班优秀学生提供更多的获得奖学金的机会，为学生提供更多创新性实验计划等项目，提供更多的相关专业工程硕士研究生推荐免试名额，提供更多的国际交流和国外学习机会，优先推荐实验班学生到所学习企业就业等。

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The Construction of Innovative Ability Training System of Engineering Students

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Abstract: The teaching group of textile machinery of Tianjin Polytechnic University has built the innovative ability training system for the textile-machinery design majors by adopting such ways as "curriculum requirements","tutor elite", "enterprise-oriented practice", "family-oriented relation", "pragmatic topics", "practice-based work" and "exchange-oriented learning". The system makes up for the lack of the traditional innovative ability training system for engineering students and improves the quality to cultivate the textile-machinery design majors in China.

Key words: major of engineering; students; innovative ability; training system

RESEARCH IN HIGHER EDUCATION OF ENGINEERI

全国中文核心期刊·CSSCI来源期刊
中国工程院教育委员会会刊
中国高教学会工程教育专业委员会会刊

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2013 增刊

坚持工程特色　引领高教前沿

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《高等工程教育研究》学报1982年由教育部党组决定创办,1983年创刊。20多年来,学报一贯坚持为全国高校服务,坚持探讨教育规律、开展学术讨论、反映研究成果、交流教育信息、推动教育改革、促进国际交流的宗旨:以其指导性、学术性、应用性的鲜明特色,深受我国高教界、工程界的好评——1992年、1996年、2000年、2004年、2008年、2011年连续六届被评为"全国中文核心期刊"。1998年11月,中国工程院成立教育委员会,负责指导与协调工程院在工程教育方面(含工、农、医等领域)的咨询研究和学术活动,就中央和地方政府有关工程教育的改革与发展提出建议,同年决定,将《高等工程教育研究》作为工程院教委会会刊。

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2013年,价格为每本15.00元。欢迎投稿,欢迎订阅。

高等工程教育研究(双月刊)

2013年增刊
2013年8月出版

主　管　中华人民共和国教育部
主　办　华中科技大学
　　中国工程院教育委员会
　　中国高教学会工程教育专业委员会
　　全国重点大学理工科教改协作组

ISSN 1001-4233

9 771001 423020

编　辑　高等工程教育研究编辑部
出　版　高等工程教育研究学报社
地　址　湖北武汉华中科技大学内
邮政编码　430074
电　话　027-87542950
总发行处　湖北省邮政报刊发行局
国外发行　中国国际图书贸易总公司
印　刷　武汉珞南印务有限公司
订阅处　全国各邮政局
国内代号　38-106
国外代号　Q927
刊　号　ISSN1001-4233
　　CN42-1026/G4

定　价　15.00元

二0一三年增刊
2013年9月

提高机构运动简图绘制与实际机械转换能力的探讨

赵镇宏　杨世明　冯志友　高淑英
（天津工业大学）

【摘　要】机械原理课程中的研究对象为机构，且都以机构运动简图的形式出现，掌握绘制机构运动简图的方法是课程的基本要求，但学生往往不能很好地完成机构运动简图的绘制，也不能很好地将具体的机械与其机构运动简图联系起来。本文分析了学生这一能力薄弱的原因，并就如何提高学生在机构运动简图同实际的机械互相转化方面的能力进行教学方法的探讨和实践。

【关 键 词】机械机构　运动简图　运动副构件

一、引言

机构运动简图就是用规定的简单线条和符号代表构件和运动副，按比例尺定出运动副的位置，准确表达机构运动特征的简单图形。机构运动简图能反映各个构件之间的连接关系、运动关系，机构运动简图揭示了机构的运动规律和特性。

在实际工程中，对现有的机械进行分析改进，首先要熟练地绘制机构运动简图以表达产品的运动特征，这是进行运动分析的必要基础。设计新的机械时，也需要对系统的构思设计方案用科学符号组成的机构运动简图来表达，这种思维结构是机构综合分析的载体，是工程设计中思维运动的飞跃，是抽象的规定到思维的具体的转变。所以掌握机构运动简图的绘制具有重要意义。

但在机构运动简图教学和实验过程中发现一些问题。

二、教学中出现问题及原因

绘制机构运动简图的目的就是要清晰地表示出机械的组成、运动副形式和机构运动传递关系，以便于对机械进行运动和动力分析。为此将那些与机构运动无关的外部形态撇开（如构件的材料、截面形状尺寸、组成构件的零件数目和运动副的具体结构等），而只把决定机构运动性质的本质上的东西抽象出来（如运动副的数目、类型、相对位置）。

学生在学习了机构运动简图这一内容以后，认为所学的概念比较简单，但当根据教学模型或实际机械绘制机构运动简图时却暴露对概念的理解还处于比较肤浅的层面，没有真正深入理解。如一些学生还是参照实验模型的外形进行构件的外廓勾画，对于实际的机器就更难分析了。所以不能撇开构件的外形等外在因素，究其原因就是对绘制机构运动简图的目的及其概念没有深刻理解，为此要强调其“机构的组成”和“构件的运动尺寸”是其“运动传递”的根本，是“运动性能”的根本决定因素。比如曲柄滑块机构可以用在内燃机中，也用在推料机、压缩机等等各种机械中，虽然曲柄的形状、滑块的外形和功能不尽相同。但只要是同种机构其运动简图都是相同的。

学生虽然见过一些机器，但一般只见其外观，对其构造、组成原理、运动情况等无法了解，学生还不能很好地把实际的机器和机构运动简图这种抽象符号联系起来。学生在遇到转动副、移动副的扩大这样的演化机构的时候不知如何下手。学生绘制类似机构运动简图感到困难，在于不能正确分析各个构件之间的相对运动实质，被复杂的外表所迷惑。虽然按照绘制机构运动简图的步骤，强调了视图选择的重要性，但在绘制过程中依然会出现一些问题。虽然知道要选择合适的视图，但最终表现为某些构件运动副是从另外的视图表现的。

三、采取的教学措施

根据前面的分析，那么是不是就不需要了解诸如“曲柄、连杆滑块什么样”、“曲柄怎样用所谓的转动副与机架相连”等等这样的问题呢？

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Advances in Education Research Volume 5

(10)

Education and Education Management

Hong Kong, September 4-5, 2012

The Teaching Method of Engineering Cases and R & D Projects in the Training Process of Excellent Engineering Talent

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Keywords: Excellent engineers, Engineering examples, Project teaching

Abstract. In this paper, the teaching method of engineering cases and R & D projects was proposed based on the national implemented overall program of excellent engineers and training standard of Mechanical Engineering and Automation. It is a teaching method which fully embodies the concept of modern education. Engineering practice is the main teaching direction. The student's ability of comprehensive engineering practice will be enhanced in some way of multi-dimensional, spiral and staggered integration. Because the differences in focus on teaching content between engineering examples and project teaching, individualized and personalized training methods will come true. Practice shows that this teaching method not only improves the efficiency of the class, but also stimulates the interests of the students. The teaching effectiveness is very significant.

卓越工程人才培养中的“工程案例与项目混搭”教学法

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关键词: 卓越工程师; 工程案例; 项目教学

中文摘要. 本文根据国家实施“卓越工程师”的总体方案，结合机械工程及自动化卓越工程师培养的专业标准，提出了一种以工程实践为导向、充分体现现代教育理念的教学方法——“工程案例与项目混搭”教学法，多维度、交错融合、螺旋式提升学生的综合工程实践能力，通过案例与工程项目内容侧重点的差异来实现因材施教和个性化能力培养。实践表明，

工程及自动化卓越工程师主要是等养在现场从事产品的设计、生产、营销、服务或的施工、运行、维护的应用型工程人才，侧重于现代纺织机械设计及自动化的综合求学生具有一定的创新性思维、较高的工程素质以及一定的组织能力，能胜任机械动化领域工作[1]。而传统的“基础课——专业基础课——专业课”三段分割的教学不能满足机械工程及自动化卓越工程师培养的专业标准。因此我们提出把工程案例项目教学法三者有机结合（“工程案例与项目混搭”教学法）、交替应用，激发学生、时刻树立工程概念。

案例与项目混搭教学法优势

教学方法，侧重于理论教学，往往以理论为主实践为辅，教学过程中针对性不强，差，一味的教授而得不到学生的反馈信息，教师的讲授基本上处于失控状态。课堂为中心进行教学活动，包办代替过多，忽略了学生的主体作用[2]。工程案例与项目法使学生通过了解工程实际需要，带着问题学习，并以主人翁的精神主动向老师求培养学生的自主学习能力、科研创新能力，良好职业素养、分析能力、沟通交流能协作能力、管理能力、表达能力等工程综合能力，从而具有独立从事纺织机械设计开发与研制、管理与营销等能力。

案例与项目混搭教学法应用

教学法

教学法应用基础

养未来卓越的纺织机械设计工程师为目的，在校企合作育人的模式下，由相关企业术人员、兄弟院校及本校的专业教师、学生组成的多单位、多学科、多层次的，为研制高速、高效、高质、高自动化的新型纺织机械设备的合作团队——“高新纺机室”。在“高新纺织机械设计工作室”校企合作平台下采用“递进培养”、“项目教学”、”[3]等方法培养学生的科研创新能力，使其毕业后成为一名卓越的纺机设计工程师。满足项目教学需要，从联合培养卓越工程师的合作企业中聘请了十几名理论基础扎实践能力强和富有较强责任心的生产一线工程师担任项目实践指导教师，并按学校兼职工程师计算和发放课时津贴，让他们的价值得到体现，还调动了他们指导学生

项目教学过程中的课题题目全部来源于企业的科研项目或攻关课题，让本科生直学研究前沿方向从事科研或技术攻关[4]。具体培养方法，如图1所示。

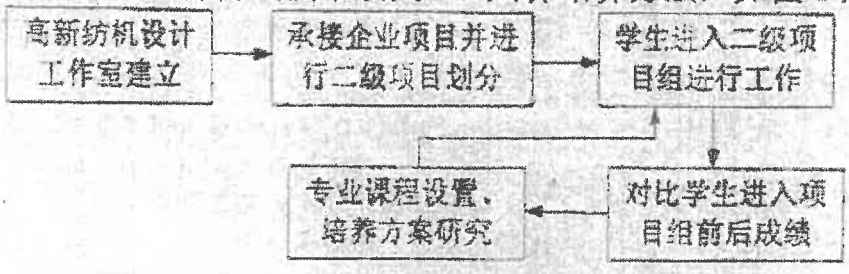


图1 培养方法

教学法实施过程

（1）确定项目任务

结合学生专长让学生进入不同的项目组，学校老师与企业工程师共同指导学生进行市场调研，检索与项目课题相关的国内外文献、专利，了解项目课题国内外研究状况，确定项目任务。

（2）制定工作计划

每个项目组从学生中选择一名学生组长，负责带领小组成员集体讨论及制定工作计并及时将工作计划向导师汇报，由导师进行修改优化。工作计划中应包括项目完成时点及详细任务分配，项目组成员必须严格按照时间节点完成任务。

（3）组织项目实施

由学校老师监督，企业工程师指导项目组学生进行技术准备、方案设计及论证、工计，最后进行成果鉴定。在实施过程中，通过“现代纺织机械设计工作室”的桥梁作用校可充分借助企业先进的制造设备、仪器、管理和优秀的工程技术人员等来全方位培养实践能力，学生根据所学专业基础理论知识和生产实践知识完成项目的前期工程设计，基础上进入企业实习，评述生产工艺制造流程、学习主要生产设备的操作使用及其管理，分析讨论生产过程中碰到的主要技术问题及其解决办法，进而提出自己的创新想法理化建议。企业用最新的科研成果充实教学，学校及时了解企业需求，推进教学改革。

（4）检查考核评估

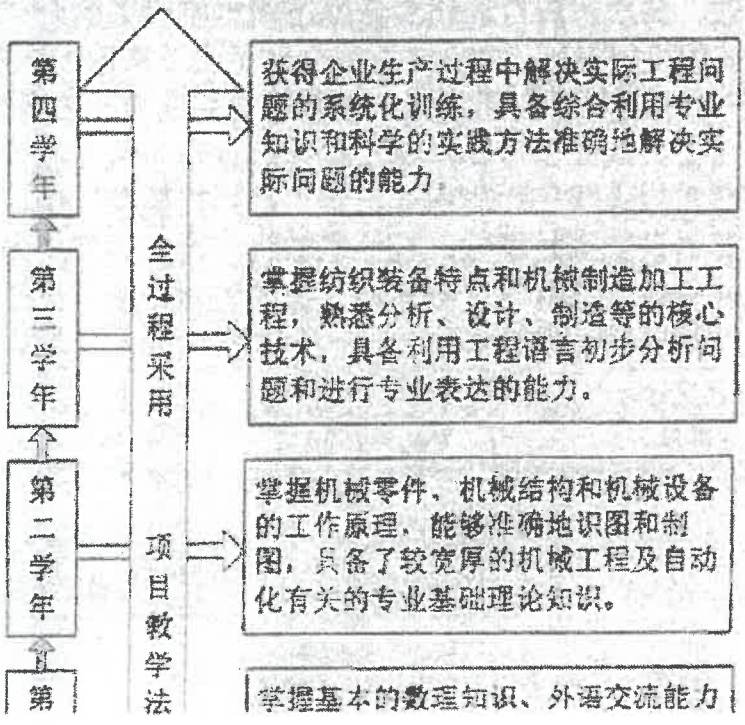
项目完成后由学校老师与企业工程师共同进行成果检查，以企业实际生产制造标准考核评估。

（5）总结评比归档

学校专业老师与企业工程师对各项目完成情况进行总结评比，并按完成时间归档。

3.1.3 项目教学法专业知识保障

在整个项目教学法的实施过程中以如图 2 所示的“专业能力“递进”“培养方式对应纺织机械设计及自动化卓越工程师的教学计划进行科学合理安排。



案例教学法含义

教学是从学生学习专业基础课（如机械原理、机械零件）开始，贯穿学习整个过程，
纺织机械设计工作室的项目选择有代表性的主机、部件、零件为例进行教学，特别
外纺织机械装备上的专利作为案例，更有代表性。教学过程中，教师扮演着设计者
的角色，通过鼓励学生参与从而达到自主探究目的。

教学法的实施

案例展示

时教师利用十分钟左右的时间展示与本节课内容密切相关的案例，案例的选取应注
时效性、典型性及尽可能具有的趣味性。学生通过感兴趣的案例去认识、思考和
主动去结合课本，试图去发现问题、解决问题，这是案例教学成功的重要前提[9]。

案例分析

讨论是案例教学法的核心环节，如何把握好此环节，是案例教学成功与否的关键。
其中，教师可以把学生分成若干小组，以组为单位进行讨论，每组可指派代表向全
案例作以分析，阐述自己的观点，这样一方面通过学生的叙述，可以了解他们对基本
本技能的掌握情况，另一方面让学生在合作交流的过程中互相学习，分享学习成果，
共同提高。教师在整个讨论过程中要扮演好导演、教练的重要角色，及时正确地
协调沟通，使讨论顺利得进行。

举一反三

结束后，由教师根据教学要求进行引导并和学生共同归纳总结，当理清知识要点，讲
学内容之后，学生已经初步理解了课本的理论知识，教师可以联系实际再次展示新
让学生利用所学知识进行分析，或创设案例情境，让学生进行演练，以达到举一
的。

有待改进的问题

工程案例与项目混搭教学法在卓越工程人才培养中的实施，我们认识到工程案例与
教学法在应中还存在不足之处，有待进一步完善和改进。

学生自学能力有待提高

经过多年教师课堂教学、单方面授课的学习，多数学生缺乏自学能力、通过实践学
思考问题较为单一，思维局限，这就要求我们在今后的教学过程中逐步引导，注重
让学生多见、多想、多动手，开阔视野、发散思维，一步步提高自身职业素质与

教学内容注重与企业接轨

的教学都是以书本为主，教师按照书本内容授课，学生形成思维定势，然而接触实
上却不能很好的将理论与实践相结合，企业随着科技的进步，实践方法与规范在逐
实用性强于书本[9]，因此，在今后的教学中应注重于企业接轨。

“案例与项目混搭”教学法强调工程实践，面向纺织机械行业生产一线，培养能综
电、气、光、仪等专业知识设计纺织机械的应用能力，具备懂技术、会管理、兼
责和科学精神的工程技术人才（应用型工程师），强调理论和实践的一体教学，进一
学效果，我校应该全面推广该种教学方法[10]。

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