

## Teaching Reform of “Air Conditioning Engineering” Course

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**Abstract.** The teaching reform of air-conditioning engineering course is discussed in the paper. For the purposes to cultivate skilled on-site engineers, the teaching reforms are carried out in the three aspects, i.e., the optimization of teaching contents, the reform of teaching method and mean, and the reinforcement of practice teaching. As a core course for the major of Building Environment and Equipment Engineering, it is important to combine theory and practice closely to enhance students' engineering consciousness, innovative spirit and practical competence to meet the specialized demand.

### Introduction

The specialty of Building Environment and Equipment Engineering in Shanghai Institute of Technology was set up in 2003, and from then on, “Air conditioning engineering” became one of core courses for the major. After nearly 10 years of teaching practices, teaching mold of major training, which is consistent with school-running orientation, is formed gradually. As an applied technology college, the localization of our running-school is to foster qualified and applied technical field engineers with innovation spirit and practice ability. Compared to other local colleges or universities with the same major, the number of recruiting students in other colleges is shrinking, and at the same time, most of their students hope to continue their education as graduate students. However, most of our college graduates work in the enterprise usually, such as construction and real estate company, industrial equipment installing company, consulting firm, property management unit, construction equipment manufacturers and so on. So, students' career planning and objective are in accord with our major cultivating goal, i.e., training and developing advanced applied high-tech talent with professional knowledge and engineering ability in the fields of engineering design, construction & installation, construction property management, enterprise operating management and scientific research.

“Air conditioning engineering” is one of core courses for the major of Building Environment and Equipment Engineering. The course covers several basic disciplines and tightly linked with the engineering practice, so it is a combined curriculum of theory with practice. For the purpose of training students' engineering design ability, engineering management ability and innovation ability, teaching discipline should strengthen students' engineering practice ability. Thus, to promote reform in education strongly is very necessary [1]-[6]. For this reason, the following aspect of work in the course construction and teaching practice is carried out.

### Optimizing Teaching Content Based on Training Objectives

The class hours for this course are 56 credit hours, including four experimental teaching (a total of eight credit hours). So within the limited teaching hours the teaching content should be optimized. According to the cultivation strategy in our school, i.e., "solid foundation, broader profession, intensive capacity and emphasizing on applications," as well as the education philosophy, which is "advocating practice, returning to project, cultivating talents ", teaching key points should lay

emphasis on training students' ability to analysis and solve the problem, enhancing engineering practice ability. Meanwhile, we should focus on the introduction of new technology, new equipment, design norms and standards in air conditioning system. Through the learning of the course, students must master air conditioning process and the operating principle of the equipment, as well as the design principles and methods for air-conditioning engineering.

The course is related mainly with basic theory courses such as “Thermodynamics”, “Heat Transfer”, “Fluid Dynamics”, “Heat and Mass Transfer Principle” and so on, and among which parts of content are overlapped. For example, the enthalpy-humidity foundation for wet air, air thermal and humid processing principle, the thermal calculation of surface heat exchanger and spray chamber, air flow distribution regular and so on were taught in above mentioned basic courses previously. So we should lay a solid foundation when these courses were taught in the beginning so as to avoid repeating these contents in follow-up courses.

Throughout the whole course, relatively complex and tedious content is mainly the load calculation of air conditioning system, so, while the teaching basic calculation method to students, also we take some time to introduce the professional computing software, emphasize the importance of the application of professional software, and demand students to master at least one kind of the professional computing software, so mastering a kind of software makes the students get rid of the cumbersome calculation. As the development of information technology and the popularity of professional software more and more, most of the students can master and use software in a short time. Then the software is also used in subsequent course design and even in the graduation design by students. In particular, it is convenient and beneficial most for the graduation design. In all of the teaching content, three basic centralized, semi-central and distributed air-conditioning systems are taken as the core content and skill to be required for students. Among them, the enthalpy wet drawing, calculation methods of the process, operating equipment principle and selection of equipments, etc. are demanded to be mastered for students. In addition, with regard to some new development of air conditioning system in recent years, such as variable refrigerant flow type of air conditioning system, energy-saving type of heat pump air conditioning system and so on are also introduced to establish the concept of energy conservation, environmental protection and green building for students. The introduction to engineering design specifications and standards, the use of design manual or handbook and so on is especially regarded to make the students be familiar with engineering design methods in advance.

### **Improving Teaching Methods and Means, Enriching Practice Teaching**

As the development of information technology, nowadays the way of lecture is mostly in the form of multimedia courseware with blackboard writing. The multimedia technologies are one of the important ways to improve the education quality and the teaching means, and to promote teaching modernization advancement. The course involves the air conditioning system and many devices which are relatively complicated, so the use of multimedia teaching courseware with rich text and graphics and simulation video materials can improve the visual and auditory effect of lectures greatly, increase classroom teaching information, display the inner structure of equipment, make the complicated boring operation process of equipments become vivid process, and at last, increase students' interest and attention. Meanwhile, we should pay attention to the research of teaching method and multimedia teaching arts, actively explore new ideas to change traditional teaching methods (i.e., the infusion of abstract and pure theory). In classroom teaching, we also emphasize the interaction with students, push heuristic education and discussion-based teaching method. After the end of the course, through questionnaire survey we facilitate the improvement of the teaching next rounds based on the students' feedback on the teaching.

In addition, the teaching with the case of practical engineering by the use of video of actual construction process which shows system design and operation process can improve the students' perceptual knowledge of actual engineering process, make up for the inadequacy of the teaching for practice project in the classroom. Introducing enterprise engineers and experts into classroom to lecture latest development achievements and engineering design method will broaden students' field

of vision, closely integrate theory with practice, develop students' engineering consciousness, and motivate students' interest and motivation in the learning of the course.

Writing essay as homework is also one of our extra practices often. It will make students' have to read references widely in thinking about problems, deepen students' understanding to the content of the course and professional development frontier comprehensively. Moreover, by taking advantage of the network, we introduce relevant professional website to students to access and obtain relevant information to enrich the teaching content and broaden the students' professional view. We also establish the on-line question-answering system to know the learning effect and adjust teaching content in time. Therefore, the network will play an important role in the teaching in the information age.

Practice teaching is done mainly by the internship, in-class experiments and course design in a different stage. We also invited enterprise's technician to hold lectures in the classroom to enrich and strengthen the education in engineering application. "Air conditioning engineering" is a course linked tightly with practice, so, practice teaching combined with theoretical teaching in the classroom can enrich teaching content, enhance students' engineering consciousness and engineering practice ability. Cognition practice, production practice and graduation practice are three important practice components to cultivate student's practice ability. In our practice bases, students' practicing and learning in the construction sites will strengthen students' understanding to actual air conditioning system, main equipment and equipment installation, operation and management and so on, and will increase students' engineering practice experience, enhance students understanding and recognition toward the major.

Experimental teaching in lab is also an important content of the course, through the experiments we can deepen students' understanding to the teaching content in classroom teaching, consolidate the learning content and knowledge, train students' hands-on ability and basic skills and enhance students' ability to solve practical problems. Currently in our major air conditioning experiments include: determination of the meteorological conditions, thermal performance test for envelop enclosure, performance test for water loop heat pump unit, performance determination of the air conditioning unit. In the future, we will gradually improve the comprehensive, designing and innovative experiments to strengthen experimental teaching.

A two-week course design for air conditioning engineering is done after the completion of the course teaching. Engineering case is taken as a teaching example generally. By visiting the construction site and inviting engineering technical personnel to lecture in the classroom, our students can know more details of the project, design idea and design concept. In the course design, load design calculation using professional software and the engineering drawing using CAD drawing are required for the students. Besides, learning to use a variety of related design manual or handbooks and expressing design ideas clearly in engineering drawing which is accordance with design and criterion request are also important to train students' engineering design ability. A good course design will be benefit for the future graduation design.

### **Enhancing School-Enterprise Cooperation to Promote Teachers' construction of the Course**

Owning a group of teachers with reasonable structure, teaching competence and high academic level is the key and is also primary task for curriculum construction. We focus on young teachers' training, and especially put emphasis on teachers' engineering training and engineering background. By sending young teachers to the design institute with school- enterprise cooperation to participate in the engineering projects periodically, the teachers' engineering design capabilities are increased considerably. Obviously, it is helpful for the practice teaching to train students' engineering design ability, innovation ability and creative ability. So, the construction of a contingent of double-qualified teachers is the requirement to meet practice teaching and to improve the teaching quality. Meanwhile, in order to increase the students' engineering practical ability, we strengthen actively practice base construction, enhance university-enterprise cooperation, provide more chances and venues for the students' training and practice and increase students' engineering practical experience. Therefore, relying on the enterprise and enhancing the university-enterprise cooperation is an important way to strengthen teachers' practical teaching ability and students'

engineering practical ability.

## **Conclusion**

The specialty of Building Environment and Equipment Engineering in our college has experienced ten years of developing period. The teaching mode is gradually formed to conform to the goal of school-running orientation and professional training in our school. As an applied technical college, our aim is to cultivate future on-site engineers with innovative spirit and practice ability. Therefore it is important to improve teaching method and means, enhance the research of the teaching arts as the times progress and, especially to stress engineering education in many ways to increase students' practice ability continuously. Thus students' engineering practice and creative ability are raised obviously, and the graduates are welcomed by the job market and the employment rate maintains a higher level over the years.

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