

## Research and Practice of Practical Teaching in Engineering Specialty

Qing-Hui DAI<sup>a,\*</sup>, Jia-Ning CUI<sup>b</sup>, Xiao-Liang FAN

Department of Mechanical Engineering, North China Electric Power University,  
Baoding, Hebei, China

<sup>a</sup>dcba6789@126.com, <sup>b</sup>976318991@qq.com

\*Corresponding author

**Keywords:** Practice Teaching, Layer Model, Teaching Evaluation.

**Abstract.** In order to solve the problems existing in the process of practice teaching, analyses the connotation and denotation of practice teaching, built and implemented the practice of "four modules, three layers" teaching system. "Four layers model" of practical teaching is put forward, which is the classroom practice teaching, the experimental practice teaching, the practical teaching in the school and the practice teaching outside the school. Suggest that the practical teaching content "four close", the use of experiential teaching, research teaching, teaching based problem, so that the theory of teaching and practice teaching mutual penetration, so that "three identification, four treatment, five steps".

### Introduction

At present, there are the following problems in the course of practical teaching: the importance of practice teaching is not enough, value theory, despise practice; practice teaching methods obsolete, its form lack of flexibility, lack of innovation; in practice teaching management, the evaluation system of practice teaching quality is not clear, there is no way to establish standard practice teaching; the structure of full-time experimental teaching staff is not reasonable; for the practice teaching base outside school, the enterprise is difficult to meet the demand of practical teaching; graduation practice and graduation design in the face of employment, there is a time conflict, the quality of graduation thesis has declined. Taking a undergraduate major as an example, this paper discusses the concept, design, implementation and evaluation of practical teaching in the universities.

### Connotation and Extension of Practical Teaching

Can be experienced, A WeChat video is better than the effective of an experiment. In the era of big data today, many changes have taken place in the connotation of practice teaching, how do we define the connotation of practice teaching?

### The Connotation of Practice Teaching

Teaching is a talent training activity composed by teachers' teaching and students' learning.

Practice teaching is a combination of a series of teaching activities in which the students do actual operation under the guidance of teachers mainly. Through the practice teaching, students can acquire perceptual knowledge and cultivate practical ability and improve the comprehensive quality. In short, a practice teaching is a practical teaching.

In the traditional teaching concept, general practice teaching is considered as an corresponding category of theory teaching. That is, divide the teaching activities into in-class and off-class, even equate theory teaching with classroom teaching(in-class); equate the practice teaching with experimental teaching (out of class). Hence, the task of theory teaching is to teach discipline theory. It is the study of the theory, and its goal is to make students understand the discipline theory. The practice teaching is an extension of the theory teaching. It contains off-class experiments, internships, visits, social investigation service activities, graduation practice and graduation design, etc. This is a narrow practice teaching.

General practice teaching exists in the whole teaching process. There are two layers of the connotation of practice teaching, One refers to the teacher's "teaching", which should be derived from the practical experience of production line, The second refers to the students' "learning", which can also be directly applied to practice, be tested in practice and enhance the effect of learning.

### **Extension of Practice Teaching**

Understanding the connotation of practice teaching aims to determine the extension of practice teaching, Practice teaching is a kind of teaching method, its extension is the concrete form of practice teaching. ①The practice of teaching. Teachers must, use various teaching facilities and take a variety of teaching methods and means, according to the teaching purpose and the students' practical situation. Such as heuristic teaching, combining students' self-study and teachers' intensive lecture, guiding students to self-study, reading, writing papers, debates, answering students' questions, organizing students to discuss and organizing students to participate in various social practices, guiding students to innovation competitions, etc. ②The practice of learning. All kinds of ways that students in the teaching activities have participated in actively, including taking lessons with their own thoughts, self-study, analyze and solve problems by themselves(including theoretical issues), participating in discussions, debates, experiments, designing, computer lessons, social investigations, technology services, campus cultural activities, club activities, etc., all belong to the category of practice teaching.

### **Construction of Practice Teaching System**

Practice is an organic unified whole composed of the five elements of subject, purpose, means, object and result. How to build a professional practice teaching system? We should give full consideration to the training goal of the school, the students' specific conditions and social environment. Our university undergraduate education is a course as the unit, so design the practice teaching centering the course.

### **School Level of Practice Teaching System**

From the point of view of system, practice teaching can be divided according to different type of education, school type, subject categories, professional groups and education levels etc. Recent years, our school's practice teaching structure is according to the four modules (basic experiment module, campus practice module, and the simulation practice module, off-campus practice module) to organize. Campus level experiment teaching content is according to the three levels (confirmatory experiment, comprehensive and designing experiments, research experiments) to design.

### **Professional Level of Practice Teaching System**

Engineering major curriculum system is composed by the public foundation courses, professional courses and practice teaching, showed table 1, a total of 200 credits.

Table 1. Categories of Courses in the Talent training Program of Engineering Major.

<b>Course category</b>	<b>Credit</b>	<b>Proportion</b>	<b>Remarks</b>
Public basic course	76	38%	Required and elective courses
Professional courses	66	33%	professional basis, required and elective courses
Practice courses	58	29%	In-class experiment and graduation design
Total	200	100%	

On the basis of campus level practice teaching system, combined with engineering major personnel training plan, we determined the engineering major experimental teaching content, showed table 2.

Table 2. Experimental Teaching Content of Engineering Major.

Type	Experimental teaching characteristics
Basic experimental	Unified guidance and the typical demonstrations by teachers, student independent operation, emphasizing the basis
Design experimental.	To complete the experiment with independent design and group cooperation, Highlight professional characteristics
Comprehensive experimental	To complete the experiment with independent design and group cooperation, develop comprehensive ability
Innovative experimental	Students' independent design and teachers' guidance, cultivate the spirit of exploration and innovation ability

We should strengthen the design of practice teaching system, in addition to clear the design of practice teaching content [1]. Practice teaching management is broad, with multiple objectives, process is complicated, need to coordinate the relationship between layers of face-to-face, and the management difficulty is greater, compared with theory teaching. Therefore, it is necessary to strengthen the system design of practical teaching design, in particular, the clarity of the system, enforceability, and monitor ability.

### Effect of Practical Teaching

The teaching mode of Industrial engineering's practice teaching in our school is, Take the student as the main body, teachers as the leading and practice ability training as the main line, *The requirements of the experimental teaching implement*, ① Teachers should censor the experiment scheme, students should preview, preparation and formulate the experimental scheme to ensure the safety and feasibility. ② In the experimental process, teachers should be less interference and pay attention to the final experimental results and the discussion of the results. ③ Teachers should guide students to write high quality experiment report. Encourage students to publish academic theses. ④ Teachers should make a summary of teaching after guiding students to complete the experiment.

The planning and construction of industrial engineering specialty in our university are based on the mechanical teaching platform, Focus on relying on the school's national experimental teaching demonstration center "North China Electric Power University Engineering Training Center". The national special major of our institute, mechanical engineering and automation, and provincial key laboratory of advanced design and manufacture, because of the attention of the leader and the support of functional departments, the industrial engineering specialty becomes an important part of the institute below the advanced manufacturing system platform, sharing teaching experiment resources. In May 2015, in the 4th National College Students Engineering Training Comprehensive Competence Competition finals, the team composed of mechanics department students of our school won the first prize. This is also the third time that the team of our department won the first prize in this competition. I guide the students in 2008 won the University Entrepreneurship Plan Competition Provincial Grand Prize, 2010 Challenge Cup Provincial Grand Prize, National Silver Award.

### Evaluation of Practical Teaching

Each level of practice teaching evaluation system, should include of the four elements, evaluation body, evaluation object, evaluation content and evaluation criteria. The evaluation criterion of practical teaching should be docked with the international standard. "The ability of solving complex engineering problems" in engineering professional certification has put forward higher requirements to the practical teaching, which is more and more important. In the 12 term graduates ability for "graduation requirements", there are 8 term requirement that is the ability to solve complex engineering problems, especially the clear requirements of "the design/development solution", the experimental "study", "the use of modern tools".

Type of practical links in engineering professional certification: ①simple experimental class; ②experimental lessons in the theory course; ③integrated practice; ④large-scale projects in theory course; ⑤scientific research training and practice outside the classroom.

Practice teaching quality evaluation system monitoring points should include the following four points: ①practice teaching environment; ②indemnity of practical teaching; ③practice teaching process; ④practical teaching effect.

### **Model of Practical Teaching Layer**

There are two reasons why there is a wide range of practical teaching. Firstly, students are the mainstay of teaching activities. In the teaching process is bound to fully reflect the purpose, means, objects and results of students learning, that is, make the "theory teaching" reflects the practicality of students. Secondly, in teaching practice, theoretical teaching and practical teaching are always intertwined. Students not only can learn theory in practical teaching (for example, the general summary of practice teaching, rose to the theoretical part), but also in theoretical teaching to learn practical knowledge and skills (for example, the theoretical teaching of the link with the actual part of the analysis, discussion, for solving the theoretical needs of the classroom demonstration).

In this paper, a new model of practical teaching layer is put forward: practice teaching can be divided into four layers: *classroom practice teaching*, *experimental practice teaching*, *school practice teaching* and *outside school practice teaching*.

The first layer classroom practice teaching, it is a base to understand and master the knowledge. In the classroom, it is required to use a variety of teaching forms that can give full play to the role of students as the main body according to the needs of "teaching" and "learning".

The second layer experimental practice teaching is the expansion of experience and application of knowledge; requires students in the laboratory to consolidate theoretical knowledge and deepen understanding of the theory, training students to master the scientific methods and improve practical ability.

The third layer school inside practice teaching, is refers to the teaching plan, the teacher has the explicit request, the student to be engaged in the practice activity in the campus. Teachers according to the characteristics of students and their needs, so that students have a choice to participate: the preparation of classroom teaching, the continuation of classroom teaching and a variety of campus cultural activities.

The fourth layer school outside practice teaching, is the extension of the previous three layers of practice teaching, the main forms are: the curriculum practice (including visits, interviews, research, design, creation, production, internships, etc), the social service of the holidays, the graduation practice, graduation design, etc.

In short, the practice teaching is to participate in the creation of a variety of science and culture, deal with a variety of social relations and a variety of production practice activities. This is the connotation of the generalized practice teaching.

From the perspective of teaching management, this layer model blurs the boundaries between theoretical teaching and practical teaching. However, in view of all kinds of bad phenomena in current classroom teaching, highlighting classroom practice teaching is conducive to improving the teaching effect and improving students' learning quality, I have learned it from the course of the provincial excellent course "mechanical system design", pilot "research teaching". The role of classroom practice teaching can be comparable with the experimental teaching practice.

### **Practical Teaching Suggestions**

①The "four close" is a link basic content of the practical teaching link: the curriculum experiment closed to the actual environment; production practice close to the actual situation of the companies; curriculum design close to the actual production; graduation design close to the professional practice. ②*Trial - oriented teaching*. It is an example of the use of tablet PCs, smart phones and other mobile internet terminal to tutor students to experience the quality of teaching resources. ③

Try to use *research teaching*, Its example is a teaching model based on the problem. ④ Encouraging *the mutual penetration of theoretical teaching and practical teaching*. The teaching activities are divided into theoretical teaching and practical teaching; this is an artificial segmentation to facilitate the teaching and management. In the course of carrying out teaching activities should not be subject to this limitation, management should provide room for reform.

On teaching content, we may be doing "*three identification, four treatments, and five steps*". Correctly identify the basic problems, key problems and difficult issues; correctly handle the old problems and new problems, unit problems and integrated issues; focus on students to identify problems, ask questions, analyze problems, solve problems, prevent problems integrated application capacity.

### **Summary**

On the construction of practical teaching system of engineering major in our college, around the training objectives, relying on the advantages of mechanical engineering and automation disciplines, Around the training objectives, relying on the advantageous subject of mechanical engineering and automation, based on the experimental teaching platform of mechanical, integrate existing resources, gradually establish a sound engineering major professional laboratory, cooperate with local enterprises actively, establish school - enterprise cooperation of teaching and research practice base, and explores a road of practical teaching. Practice shows that if a profession wants to continuous progress and develop with continuously with the development of the times. The construction of the practical teaching system should be closely integrated with the construction of the theoretical teaching course. Only by following the trend of the development of the times, can it help to cultivate professionals who can meet the needs of national construction.

### **Acknowledgement**

This research was financially supported by the Professional Comprehensive Reform Pilot project of the Higher Institutions of China's Ministry of Education (No.: 13041501).

### **References**

[1] Hongliang Zhang, Zhenhua Gao. Research on the Integration of Experimental and Practical Teaching of Industrial Engineering. *Journal of Anhui University of Technology*, 2015, 32(3): 91-92