

## Reform of Training Ways of Engineering Practice and Innovation Ability for Petroleum Engineering Students

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### Abstract

To improve the students' ability of engineering practice and innovation, Petroleum Engineering Experiment Teaching Center reformed the training ways, including construction of two-way practice teaching system, reform of the experimental teaching organization and management mode, experimental teaching mode, experimental teaching contents, experimental teaching assessment methods, form and content of college students' extracurricular scientific activities, etc.. These help to form the good situation of independent learning and independent experiments, training students' engineering capability and innovative capability, which have achieved fruitful results in practice.

**Key words:** Engineering practice ability; Innovation ability; Teaching system; Experimental teaching; Teaching reform

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### INTRODUCTION

In recent years, under the promoting of the construction of experimental teaching demonstration center in

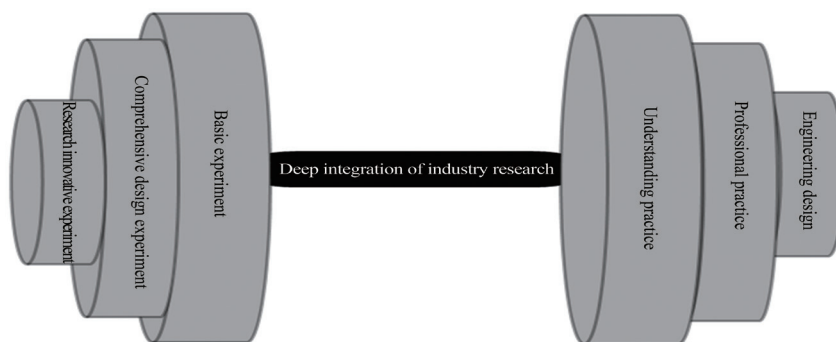
universities, colleges and universities to deepen the reform of experimental teaching, training students' ability of engineering practice and innovation ability carried out a large amount of exploration and practice, and have obtained many for the reference of the research results and practical experience (Kawworm & Hemmingsen, 2007). Since Petroleum Engineering Experimental teaching center (hereinafter referred to as the center) in Northeast Petroleum University established, in many years of teaching practice, always adhere to the "students oriented, knowledge transfer, ability to develop, improve the quality of coordinated development" of the education idea, and gradually formed a "ability to develop as the core" of the experimental teaching ideas.

In the discipline of petroleum engineering, it is clear that to strengthen the practice of teaching, to cultivate students' experimental skills, process operation ability, engineering design ability, scientific research ability and social practice ability, etc., and then develop the students' engineering consciousness, improve students' practical ability and innovative spirit (Kappel, Lehmann, & Loeper, 2002). In recent years, the center has carried out a series of reforms and exploration on the practice ability and innovation ability of college students based on the discipline of petroleum engineering. Center through optimizing the teaching content, reform the teaching mode of experiment, the formation of the teaching mode of combining the theory and practice, construction of the petroleum engineering professional "barbell" two-way practice teaching system, by combining with the college students' extracurricular activities in science and technology, expand the ways for width and optimize the students' ability of engineering practice and innovation ability training and achieved remarkable results.

## 1. BUILD A BARBELL TWO-WAY SYSTEM OF PRACTICE TEACHING

Engineering practice is an important part of engineering education, usually refers to the practice of engineering students in the practice of education. Students need to learn professional knowledge for practice, in order to consolidate and improve the level of knowledge, improve the ability to practice, and strive to solve engineering problems through practice. At present, with the rapid development of social economy, for the training of qualified personnel and higher, and higher education in teaching and production of touch, the disconnection between theory and practice problem is becoming more and more serious, how to strengthen the practice teaching, to ensure that students' ability of engineering practice and innovation culture has become to improve the quality of higher education faces the bottleneck problem (Strong, 2012).

At present, the cooperation between university and industry has become an important way to strengthen the connection between the university and the society, serve the economy development and cultivate students' innovative spirit and practical ability. In this context, petroleum engineering experiment teaching center according to the characteristics of petroleum engineering, take the initiative for the oil industry's demand for talents, actively change their ideas, completely abandon the teaching experiment for dependency of theory teaching idea, set up the experimental teaching is petroleum engineering professionals training concept of "one of the most critical factors, optimization and integration of the laboratory experiment and field practice, to the combination of depth fusion as a bridge and construct the barbell type bidirectional practice teaching system of combination of laboratory experiment and field practice, as shown in Figure 1.



**Figure1**  
**Schematic Diagram of the Barbell Type Two-Way System of Practice Teaching**

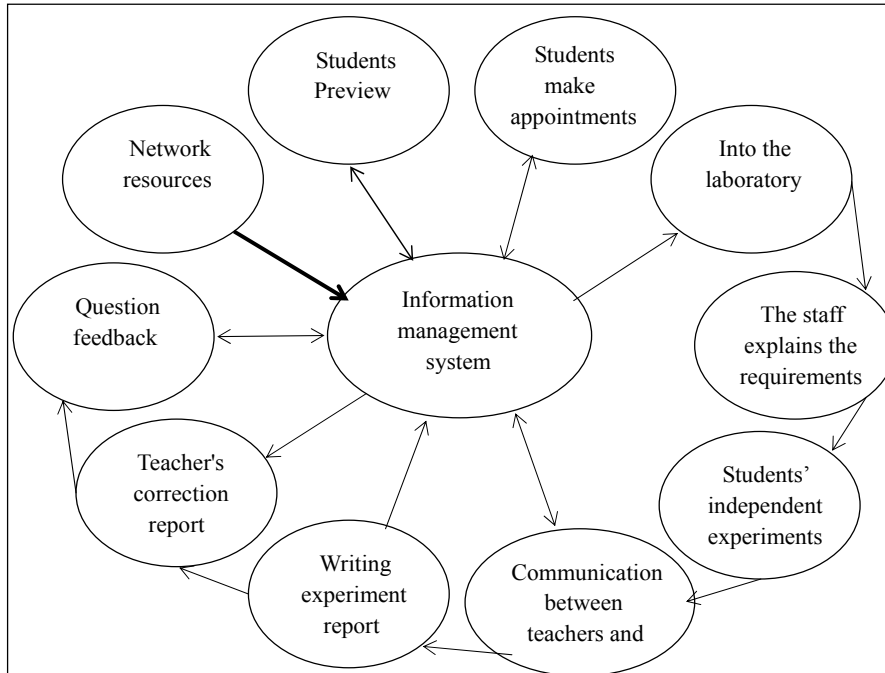
This system consists of two modules, which are indoor experiment and field practice, which is divided into 3 levels: The first level is the basic type, which aims to deepen students' understanding of basic concepts, verify the basic rules, grasp the basic experimental methods and skills, cultivate the ability of students' comprehensive application ability and experimental design. The third level is to cultivate students' research ability and innovation ability. Mine practice module is divided into 3 levels, the first level is to understand the practice, the students are trained to form a visual perception; the second level is a professional practice, students through the work with on-site engineering and technical personnel to eat, live, work, learn to operate skills, to find practical problems, and take the problem into professional courses.

In this system, the indoor experiment and field practice module are independent, and the mutual exchange, but also mutual promotion, through the depth of integration,

so that college students can get on the basis of experiments and based on the comprehensive training of engineering, training the engineering practice ability and innovation ability.

## 2. REFORM EXPERIMENT TEACHING ORGANIZATION AND MANAGEMENT MODEL

In recent years, the center of the construction and planning, uphold the experimental teaching and theoretical teaching "co-ordination, mutual promotion, common development, improve the quality" of the guiding ideology, and actively carry out the reform and exploration of experimental teaching mode, set up a set of "Open", decentralized, reservation, self-help in one of the experimental teaching mode, as shown in Figure 2.



**Figure 2**  
**Schematic Diagram of Experimental Teaching Mode**

Open, that is with the aid of laboratory intelligence, information management system platform, to co-ordinate all kinds of experimental teaching resources, the center of all laboratories for college students in the experiment, second classes, graduation design and scientific research to implement a comprehensive open. Dispersion, that is to improve the students' experimental freedom, students do the experiment time and the total time in the laboratory does not make an unified requirements, students are no longer limited to the same time and the same project. Reservation, that students use the network resources in the teaching resources to prepare, and then through the laboratory of intelligent information management system to make an appointment for the experiment, according to the time of the system arrangement. Self-help, that is, the students choose the experimental project, the independent design of the experimental procedure, to complete the experiment, the teacher only when necessary to give guidance and help (zoltowski, oakes, & Assistant, 2012).

The experimental teaching mode is based on the laboratory intelligence and information management system. The college students use the network resources, such as the equipment, the experimental video, the experiment and the experiment. According to the time and place of the system, the students enter the lab by the credit card. In the lab, the teacher only explains the experiment's notes, in principle, no longer explain the principle and process of the experiment. When the students are independent experiments, the problems encountered in the process of the experiment should be resolved through their own thinking. After the end of the experiment,

students and teachers through the interactive platform of information management system, experimental report submitted, marking, the communication of experimental technology, problem feedback and so on.

The experimental teaching mode follows the idea of "students as the main body, the teacher as the leading, the knowledge, ability, and quality coordinated development". The experimental teaching mode is realized by the integration of "open, decentralized, reservation and self-help".

### 3. REFORM EXPERIMENT TEACHING CONTENT AND ASSESSMENT METHOD

With the development of oil production technology, the requirements for the professional skills of the students in the petroleum industry are gradually improved. Center to train the students' ability of engineering practice for the purpose, to reform the content of experiment teaching as a breakthrough, not only pay attention to the experiment teaching contents combining with traditional and modern, but also pay attention to the combination of experimental teaching and scientific research, engineering, and social practice, positive research results feedback teaching, timely the achievements of teaching reform into the experimental teaching, to optimize the teaching content. Concrete measures:

#### 3.1 Adjust the Experimental Teaching Content

Large amplitude compression verification experiment, the increase of comprehensive, design, innovation and

research experiments, see Table 1, such as oil production engineering module, through independent research and development of experimental and training integrated platform, will be more than one production site and the actual process into the laboratory experiments, to achieve the reality of the practice, not only to overcome the oil

production engineering deep underground, invisible and difficult to understand, but also a good solution to the problem of the practice of the security of the field practice, but can't be trained (Chen, Lord, & Mcgaughey, 2014). Through this platform, the theory teaching and practice teaching to achieve a close combination.

**Table 1**  
**Experimental Project of Petroleum Engineering Teaching Center of Northeast Petroleum University**

Serial number	Teaching module	Former ratio			Adjusted ratio		
		Basic/%	Comprehensive/%	Innovation/%	Basic/%	Comprehensive/%	Innovation/%
1	Seepage physics	59	41	0	43	43	14
2	Drilling engineering	81	19	0	63	25	12
3	Oil production engineering	67	33	0	0	33	67
4	Oil field chemistry	80	20	0	76	19	5

### 3.2 Center Especially Creates the Innovative Experimental Credits

According to the characteristics of professional integration of experimental resources, a number of innovative experimental projects, students in 4 years to complete a certain number of innovative experimental projects, identified and obtained the corresponding credits.

By updating the content of experimental teaching, and promote the operating ability, ability of engineering design and science and technology innovation ability cultivation for petroleum engineering students' practice, presents the teaching to promote the good situation of scientific research, scientific research nurturing teaching.

## 4. REFORM THE FORM AND CONTENT OF COLLEGE STUDENTS EXTRACURRICULAR SCIENCE AND TECHNOLOGY ACTIVITIES

College Students Extracurricular Science and technology activities is a good way to improve students' innovation ability, but the present extracurricular science and technology activities have a focus on the results and the neglect of the process. There is a problem with the college students ability training, and the experimental teaching. In view of this situation, the center in order to strengthen college students' engineering practice ability and innovation ability, the college students' scientific and technological activities take the interest as the driving, the professional questions as the background, the engineering design and the innovative research as the way and the experiment center as the support. That has improved the enthusiasm of college students to participate in science and technology activities (Carpenter, 2013).

An organization method of the implementation of the extracurricular scientific and technological activities, Aiming at different levels of students in different grades,

for the students in the lower grade, because of their relative lack of professional knowledge, the physical problems, chemical problems or mathematical problems related to the practical engineering problems, Based on the knowledge of the professional knowledge and the center of the laboratory, the implementation scheme is put forward. For the higher grade students, because it already has a wealth of professional knowledge, so technology activities more to oil engineering and specific practical problems for the problem, using the professional knowledge of the center of the laboratory as the basis, independently proposed the implementation plan.

In order to improve the enthusiasm and initiative of students in the experiment, the center has set up the students' innovative experiment funds, which attract the students to enter the laboratory for innovative experiments. From 2009 to 2010, college aids student 102 innovative experimental projects, including 14 projects which were established at national level of College Students' innovative experimental programs, 41 projects were approved as university project. Through the reform of the form and content of scientific and technological activities, the students have improved their enthusiasm and initiative to participate in the activities of science and technology (Lattuca, Bergom, & Knight, 2014).

## 5. REFORM THEORY AND PRACTICE TEACHING MODE OF MINE

The students in the oil engineering specialty should be carried out in the field of Daqing oil field every year to ensure a large number of students' field practice effect, and effectively improve the students' engineering practice ability and innovation ability, and put forward the theory, Teaching mode combined with field practice. The combination of theory and practice is realized through practice.

Before the reform, the time interval between the theoretical teaching and the practice of the mine is long,



and there is no real combination. For this purpose, the combination mode of “theoretical teaching engineering, practical teaching theory” is put forward, which is to make full use of the training platform of the experimental teaching center of petroleum engineering and the 2 national experimental teaching demonstration center (Splitt, 2004). In mine practice, for each practice unit in the process of theoretical knowledge involved in the design of the relevant teaching process and problems, so that students in the internship process to fully understand the theory, to avoid the practice as a simple visit or simple production labor.

## 6. IMPLEMENTATION EFFECT ANALYSIS

Center by building a “barbell” two-way practice teaching system, reforming experiment teaching mode, optimizing the content of experiment teaching, reform the form and content of College Students’ extracurricular activities in science and technology, reform theory and field practice teaching model, a series of training ways of reform, forming a college students’ autonomous learning, independent experiments in a good situation, to improve the college students on the interest and passion for innovation, promote the students practical ability, ability of engineering design and science and technology innovation ability training, and made a large number of students scientific and technological achievements, enhance the graduates’ employment competitive power (Li, Wang, & Ha, 2015).

Oil engineering students have won a reward of the first prize of national and a reward of the second prize of national in national oil engineering design competition. 2009-2010, the students published 15 scientific papers. Over the years, petroleum engineering graduates employment rate has remained above 95%, among the highest in the province (Lin & Yueh, 2014).

## CONCLUSION

College Students’ engineering practice and innovative ability cultivation of the way is broad, still need to be further explored. In the future, the experimental teaching center of petroleum engineering will keep pace with the times, continue to update the educational concept, continue to carry out reform of the practice teaching mode and exploration of College Students’ engineering practice

and innovation ability, pay attention to the organic combination of teaching and research.

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