Reform of Practical Teaching System for Metallurgical Engineering Undergraduate Course Under New Engineering Background

Pingguo Jiang(✉), Chunfa Liao, and Huaping Nie

College of Metallurgy and Chemistry,
Jiangxi University of Science and Technology, Ganzhou 34100, China
pingguo_jiang@163.com

Abstract. Reform of practical teaching system for Metallurgical engineering undergraduate course under new engineering background emphasize on the construction of practical teaching. The practical teaching system in the process of knowledge foundation, application and innovation was realized by specialized experiment teaching, the construction of enterprise internship base and practical teaching platform of innovation education, which cultivate the specialized comprehensive quality, ability of practical application and innovation spirit of students better. It will cultivate high-quality specialized engineering human resource and eventually enhance the competence of Metallurgical engineering students in our university.

Keywords: New engineering · Reform · Practical teaching

1 Introduction

It is not only a period that economy and society have developed rapidly but also a period that high education and scientific research have developed rapidly in recent ten years. Internationally, undergraduate education development has become the strategic choice of many countries to drive the innovation development and enhance the international competence. The model of undergraduate education in our country hasn't adapt to the diversified requirement of the development of economy and society, students are scare of innovation and practice ability especially which hinder the promotion of cultivating students.

At present, the undergraduate educational model of metallurgical engineering in our school pay much attention to teach specialized knowledge inherited form early thoughts, emphasizing on the learning and promotion of theoretical knowledge but the abilities of innovation and practice are neglected. As a result, the undergraduate education model which connect tightly with cultivating the abilities of profession developing. At present, the undergraduate education of metallurgical engineering in our university is evaluated mainly based on the specific performance such as the academic performance during at school and research output of students and so on, it neglects the elements such as engineering ability, development potential, specialized adaptability and innovation and entrepreneurship ability and so on.

S. Liu et al. (Eds.): eLEOT 2018, LNICST 243, pp. 242–249, 2018.
https://doi.org/10.1007/978-3-319-93719-9_33

As the reform of undergraduate education in our university is deepening, the cultivation system of metallurgic engineering innovation human resource is urgently needed to promote the specialized quality and engineering ability and cultivate the innovation ability. Hence, the teaching system of metallurgical engineering must be transformed to practical teaching which plays an important part in the cultivation of practical human resource and practical operation ability, problem solved ability and innovation spirit of students, it can't be replaced by theoretical education [1].

2 The Existing Problems in Practical Teaching and the Necessity of Reform

The foresting program emphasize on the practical teaching to cultivate the specialized comprehensive qualities, practical application ability and innovation spirit of students [2]. But as the expansion of university, the number of students have increased rapidly, the primary practical teaching system has no longer adapted to the current situation [3] because of the development of metallurgical technology. At present, the main problems in the process of practical teaching: (1) the construction of laboratory is neglected, it can't satisfy the demand of major basic experiment; (2) it's difficult to construct internship base, the demand of production practice and graduation practice can't be satisfied; (3) it is scare of innovation education which make the cultivation of comprehensive quality meet the bottleneck [4, 5]. Hence, the metallurgical engineering practical teaching system must be reformed and optimized.

3 The Construction and Optimization of Practical Teaching System

The metallurgical engineering practical teaching includes experiments (curriculum basic experiment and specialized experiment), design (curriculum design and graduation design), paper and discussion (classroom discussion, seminar and paper) and so on. According to the character of practical teaching, the practical teaching has been modular to cultivate corresponding abilities and construct and optimize the practical teaching system. The first section is specialized basic practical teaching which cultivate the practice ability of students includes experiments (curriculum basic experiment and specialized experiment) and design (curriculum design and graduation design); the second section is specialized knowledge applied practical teaching which cultivate the practical ability of students includes internship (metalworking practice, perceptual practice and production practice) and new additional specialized investigation; the third section is the development of qualities for metallurgical engineering and practical teaching of comprehensive quality for promotion, that is innovation education which cultivate the innovation spirit of students includes paper and discussion (classroom discussion, seminar and paper) and new additional research practice (scientific paper writing) and so on. The practical teaching in the progressive process of specialized experiment, factory practice, and innovation education was presented to cultivate the operation ability, practical ability and innovation spirit of students, and to promote the comprehensive quality of students. Optimized practical teaching system as shown in Fig. 1.

Lab teaching platform, construction of internship base and innovation education platform are the key points of practical teaching system, but the neglect on construction of lab, shortage of internship base and innovation education have become the prominent contradiction of the practical teaching process. Hence, the construction of practical teaching should be taken as an important part of the establishment and optimize of practical teaching system. First, the level of experiment teaching should be promoted to cultivate the operation ability through teaching process such as curriculum experiment, intensive experiment, curriculum design and so on. And then the construction of internship base should be enhanced to cultivate the practical ability of students through factory practice such as metalworking practice perceptual practice and production practice and so on. And the innovation spirit of students is eventually cultivated through independently thinking and researching activity which is conducting special lecture face to students, scientific writing and scientific practice and so on.

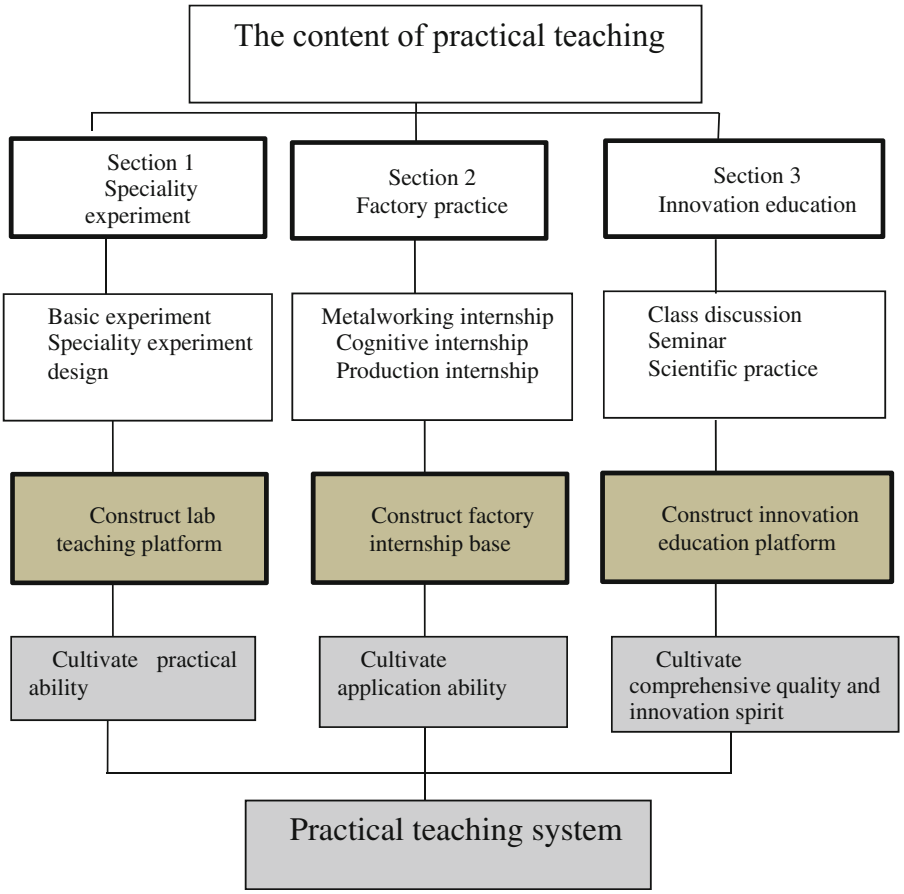

Fig. 1. The basic framework of metallurgical engineering practical teaching system

4 The Measures and Implements for Reforming Practical Teaching System

4.1 Enhance the Construction of Practical Lab Teaching Platform

Most of the experiment course are replication experiment based on classroom teaching (basic course, specialized basic course, specialized course), which is important teaching methodology of promoting basic specialized experiment skills. The goal of practicing of basic specialized experiment skills is to make students master the basic theory and basic experiment skills, the most important part of teaching is the application of instruments, the standardization of basic operation and the comprehension of basic experiment phenomenons [6, 7]. It can be concluded that the construction of metallurgical engineering experiment teaching must be enhanced on three parts as follows:

(1) The input into the construction of specialized lab should be increased. Our university focus on constructing the specialized lab of metallurgical engineering, our university have finished the input and construction of "nonferrous metallurgy lab of metallurgical engineering", "physical and chemistry metallurgy lab of metallurgical engineering" and "steel metallurgy lab of metallurgical engineering" one after another since 2006. Large stock of experimental apparatus and analytical instruments were bought, the lab instruments of metallurgical engineering were advanced and the demand of students conducting experiments was satisfied. In the meantime, major in metallurgical engineering has received financial support from "the major investment projects of local university specialized lab" of state minister of finance, constructed the "basic experiment lab of metallurgical engineering" which satisfies the beginning of experiment course of basic experimental skills of metallurgical engineering. The lab and experimental apparatus fully satisfied the demand of students in conducting experiment. Because of the improvement of experimental condition, the undergraduate experimental teaching of metallurgical has obtained good results.

(2) The construction of teaching staff. From appointed person do the appointed job to make expertise do the job. College attaches great importance to the construction of laboratory teachers, but also optimize the teaching staff of experimental teaching. The original laboratory appointed teachers are responsible for experimental teaching, due to the number of appointed teachers in the laboratory much less than the number of students, it can't achieve the desired expectation when the appointed teachers have heavy tasks. College take full advantage of teaching staff of metallurgical engineering department, the specialized teacher is responsible for the experimental teaching together, due to that, the staff-student ratio raised three times. And because of that specialized teachers undertake the experimental task that they are good at, so the teaching result improved greatly, the degree of satisfaction of student reached 100%. In the meantime, our university conducted "the internship and practice of young teachers in factories" training activities in winter and summer vacation every year. Most of the newly introduced teaching staff have PHD degree, almost 50% of the teachers have the experience of working in production line, which guarantee an excellent teaching staff for cultivating engineering and technological human resource.

(3) The management of experimental instruments. Make sure the apparatus and instruments work and being shared normally, emphasize on maximizing the service efficiency of apparatus. Due to that the key point of teaching is the application of instruments, the standardization of basic operation and the comprehension of basic experiment phenomenon. The normal conducting of specialized experiment is guaranteed by the management of apparatus and instruments. Specific specialized teacher is responsible for the management of apparatus and instruments, especially the large-scale apparatus and instruments are managed by appointed person in special project, the teachers are responsible for the normally working of large-scale apparatus and instruments and that students use them properly. When students take part in research activities, the teachers conduct students to use the apparatus and instruments according to the research needs. The less the apparatus and instruments breakdown, the higher service efficiency we can get.

The experimental teaching plays an important part on teaching activities of colleges and universities and an important path for the colleges and universities to implement education for all-around quality developing. The cultivation of practice ability under theoretical conduction is an important part of cultivating basic qualities, and the practice ability is achieved by experimental teaching in lab. The students experienced the process from cognitive to verification through the specialized experimental teaching which is the foundation of practical teaching system.

4.2 Enhance the Construction of Internship Base Platform

It can offer more perceptual knowledge of production apparatus and production technological process, and provide the example of combination of theory and practice which will develop the cognitive ability of students and inspire the learning interest. The practical ability of students in metallurgical engineering must be valued, especially the ability of analyzing and solving problems on production line. Our university pay attention to the internship in enterprise, internship as the important process of practice deepen the knowledge learned in classroom, and the students can have a good idea of technological process, equipment, project and technical operation of modern metallurgical enterprise. It cultivates the ability of observing, analyzing and solving problems of students, and in favor of students learning experience of enterprise management and the spirit of working hard. In order to promote the engineering practical ability of students in our university, the connection with metallurgical enterprise should be enhanced, the construction of internship base should be attached importance to and the production practice knowledge of engineer should be taken advantage of. Constructing the enterprise internship base, taking full advantage of enterprise human resource and teaching the student knowledge of production which is complementary with the theory teaching in the classroom.

(1) The construction of internship base was enhanced. The construction of metallurgical enterprise internship has been enhanced since 2005. The Jianxi Copper Company, Fujian Sanming Steel Company, Zhuzhou Metallurgy Company, Jiangxi Xinyu Steel Company, Jiangxi Pongxiang Steel Company, Aluminum

Corporation of China Limited in Shanxi, Aluminum Corporation of east of China Limited which all have full metallurgy technological process have become the internship of our university. For example, the perceptual internship in Fujian Sanming Steel Company is to be familiar with the whole production process of metallurgy which includes stock yard, sintering, coking, iron-making, converter, electric furnace and steel rolling. The internship in Xinyu and Pingxiang Steel Company require the students to have deep learning in posts include blast furnace, converter and electric furnace to combine the theory with practical operation.

(2) The construction of teaching staff of enterprise internship base was enhanced. Our university take full advantage of enterprise human resource to teach the knowledge of production which is the complementary of specialized theory teaching in the classroom. All the enterprise internship bases are state-owned or local large-scale pillar industries of metallurgy enterprise which have integrated staff training system and its platform is enterprise staff training center. The staff training center is transformed by primary enterprise technical school and stand for the enterprise to arrange the practice activities which have the experience of management and teaching have improved the teaching results. In the meantime, the enterprise engineers are hired to teach the production process and introduce the production apparatus which half the work with double results.

(3) The enterprise internship safety management was enhanced. Practice safely which has been put into the first priority is the basic guarantee of internship. The safety consciousness was enhanced through the safe product management system of enterprise to ensure the success of internship. For example, the first thing of practicing in Sanming Steel Company is safety education in which the headquarters is responsible for the safety consciousness, the branches are responsible for the safety measures and the plants conduct the safe practice and safety management.

The construction of enterprise internship base has ensured the success of engineering practice activities which give full play to students' proactive and enhance students' engineering awareness and engineering practice and cultivate the abilities of comprehensive apply learned knowledge of students. The students have learned the enterprise production technology and relevant regulations of management through enterprise internship which is the process from "cognitive" to "practice" of students and the deepen reform of practice teaching system.

4.3 The Construction of Innovation Education Platform

The students experienced the process of cognitive, verification through the specialized experiments which is the foundation of practical teaching system. The enterprise internship is the practical process from "cognitive" to "practice" of students and the deepen reform of practical teaching system. The innovation education is the process from "practice" to "innovation" and the sublimation of practical teaching system. The two fundamental point of practical teaching system are the specialized experiments and factory practice which also satisfied the basic requirement of cultivating engineering technical human resource. Then the innovation education is the quality development

education according to the talent and learning demands of students and the features of the major which satisfied the personality development and the aspiration of advantage promotion of students. The nature of innovation education is not to teach students how to exactly innovate, but to forest the awareness, spirit and abilities of innovation of students. And eventually inspire the desire of exploration and innovation of students. There are rules for specialized experiments and the construction of teaching platform of factory practice, but there isn't uniform way for the construction of innovation education platform which provide a proper conditions to help students develop the personality and promote personal advantage during the whole learning time in university [8, 9].

The innovation education is diversified and plentiful. According to the character of metallurgical engineering and tradition of our university, the characteristic quality development activities are conducted based on the foundation of learning demand of students which create a good learning atmosphere. The "undergraduate tutorial system" has been carry out which aim at the students have demand of promoting specialized knowledge in which students choose teachers in metallurgy department on their own and attend the research projects of teachers to investigate, work on a project, research and write papers independently. The "research activities of metallurgical enterprise" which is supported by university and lead by teachers has been carry out. The themes of investigation are chosen by students themselves, and the production technology, product sales market, new production and new technology are investigated by students going in the metallurgical enterprise. The reinforce of communicating and acquainting with metallurgical enterprise help the students to establish right employment view. The "technology activities of undergraduate" are carry out which are organized by students themselves. Excellent achievement has been obtained by encouraging students to attend the National College Challenge Cup. The "activities of metallurgical technology of undergraduate" are carry out which are lectured by experienced professor in metallurgical department and external experts and enterprise manager or plant manager. The students can take full advantage of the resource of provincial and ministerial engineering technology center in our university and social resource such as metallurgical enterprise. These activities have been carry out to satisfy the learning demand of students and to make students learn consciously which create an excellent atmosphere to realize the innovation education.

5 Conclusion

The construction of practical teaching platform as the important part of reform for practical teaching of metallurgical engineering of Jiangxi University of Science and Technology which have realized the practical teaching system in the progressive process of knowledge foundation, application and innovation through the construction of specialized lab, enterprise internship base and innovation education platform. The reform has promoted the ability of cultivating high quality engineering technology human resource who have excellent comprehensive quality, ability of practice and innovation spirit.

References

1. Jiang, J.: The engineering education must aim at engineering practice—interview record of the principle Wan Gang. J. Res. High. Educ. Eng. **4**, 1–7 (2006)
2. Zhang, W., Wang, S.: On the reform of higher engineering education from the evaluation of global competitiveness. J. Res. High. Educ. Eng. **1**, 6–10 (2009)
3. Gai, G.: Enhance the practical teaching, highlight the school characteristic and cultivate the innovation spirit and practical ability of undergraduate. J. China High. Educ. Res. **12**, 7–8 (2004)
4. Chen, G.: The practice and thought of conducting the graduate paper of steel metallurgical engineering undergraduate. J. China High. Educ. Res. **2**, 45–47 (2001)
5. Yuchun, D., Shi, Y., Liu, S.: Some thoughts on the management of experimental teaching in colleges and universities. J. Taiyuan Norm. Univ. (Soc. Sci. Ed.) **4**, 47–54 (2000)
6. Wang, C.: Reform of personnel training program and curriculum system for Metallurgical Engineering. J. Guizhou Univ. Technol. (Soc. Sci. Ed.) **1**, 17–18 (2007)
7. Pan, D., Li, S.: Exploration and research on experimental teaching reform of university's engineering speciality education. J. High. Educ. Forum **4**, 43–45 (2005)
8. Luo, S., Zhou, L., Wang, Z.: Research on the new school enterprise cooperation to cultivate the applied talents in the zero adaptation period. J. Jiangxi Univ. Sci. Technol. **2**, 57–60 (2009)
9. Xiao, W., Zhao, Y.: Some thoughts on strengthening the sustainable development of higher education in China. J. Jiangxi Univ. Sci. Technol. **4**, 75–76 (2009)