

Exploration of Practical Education Pattern From Multiple Approaches

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Abstract—Practical education is an important part in the undergraduate level college education and a vital step to enhance the professional knowledge and innovation spirits of students, which is irreplaceable in the training of students' practice skills and social service awareness. Based on analyses of status and problems of practical education in electrical engineering majors, we explored multiple improvements for the practical education, which included clarifying the education objectives, explain the education purposes, establishing the education program, renewing the education method, recruiting the faculty, and allocating education funding. The outcomes of our exploration were satisfactory with positive feedbacks from students, university, and employers, which improved the practical education purpose and received commendation from the society.

Keywords: *practical education, education mode, new engineering, innovation*

I. INTRODUCTION

The rapid development of the new economy, represented by new technologies, new models, and new industries, placed higher requirements for engineers and scientific researchers. It is urgent to accelerate the construction and development of the new engineering [1]. In 2017, the Ministry of Education issued the "New Engineering Construction Guide", which propose new requirements for engineering majors. It is necessary to establish a comprehensive system for innovation and entrepreneurship education of college students. Undergraduate level college practical education is an important part of the undergraduate professional education system. The combination of theoretical knowledge, professional knowledge, and practical application is of great significance for strengthening undergraduate students' capability in generalization comprehensive knowledge, scientific research, and independent work [2-3]. "Based on the original", "The four reintroduction", acceleration of high-level undergraduate education construction, and improving the capability of student education, are becoming the consensus of the current education and teaching reform in universities. It is an important task to improve practical education and to train engineering application-oriented innovative students in undergraduate level higher education.

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In the practical education of electrical engineering majors, the content of internship education such as visiting internships, production internships, and graduation internships is of great significance to form and improve the students' practice capability[4]. Internship education is an important step to achieve the higher engineering education objectives, especially in improving students' comprehensive practical capability and skills. Internship teaching is also important in training undergraduate students' capability to innovate and practice as well as creative spirits[5-6]. However, internship education, which has important historical commitments, begins to encounter problems and difficulties with the development of economy, society, and higher education itself. The results of internship education failed to meet the requirements of engineering application-oriented education; thus, practical education, especially internship education, has become a popular theme in the research and discussions of higher education reform.

The major problems in current internship education include: difficulties to contact internship employers, negligence from teachers and students on internship education, limited guidance from internship employers, insufficient capabilities of teachers, increasingly simplified internship contents, and failures to achieve the education objectives.

In recent years, the School of Electrical and Information Engineering of Shaanxi University of Science and Technology has developed several methods to resolve the problems encountered in practice education through analyses of the trends in industries and the requirements for the students' knowledge system and engineering capabilities. We thoroughly analyzed the intension of practical education and the framework of the entire practical education system to determine the contents of practical education, with a primary objective to improve the students' practical capability by making the students to clearly comprehend the functions, status, and effects of understand introduction internship, production internship, and graduation internship. We established an internship education system based on mutual benefits for the university and internship employers and performed an internship education evaluation mode based on comprehensive students' capability assessments. We have forged the practice education into an important step to assess and improve the theoretical education and to promote the formation of professional fundamental capability (of students). After nearly three years of preliminary operation, students generally

responded that they have a more comprehensive realization of their majors. Students also found they have better capability to discover, recognize, and analyze problems as well as independent working skills and their professional practice capabilities have been greatly improved with a primitive innovation spirits in their professional field. A series of landmark achievements such as Shaanxi Innovation and Entrepreneurship College, Shaanxi Province Electronic Information Engineering Applied Talent Training Model Innovation Experimental Zone, Provincial Quality Course, and University-level Quality Course were obtained at the same time.

II. MAIN PROBLEMS SOLVED

We have determined several problems in internship education through research and analyses in multiple aspects:

A. *Insufficient Comprehension of Internship Education*

Both teachers and students failed to fully realize the importance of the internship education. The internship education has gradually degenerated into a touring. Participants' attitude is not serious and which is prone to produce a negative external opinion and to ruin the reputation of the university;

B. *Difficulties in Contacting Internship Employers*

Employers with advanced technologies and profitable financial conditions usually are unwilling to accept internship students. Meanwhile, employers, that are willing to accept students, have inferior working environments, obsolete production management, out-of-date technologies and limited capacities in internship positions, which directly discourages students' professional interests;

C. *Contents of Internship Education is not Scientific*

Due to the difficulties in contacting internship employers related to the students' majors, there is a deviation between the contents of internship education and the objectives of professional training. Students have insufficient training in the engineering practices and study low level technologies. The contents of internship education are increasingly simplified, which easily generated a reluctant attitude to the internship from students. The objectives in the syllabus of internship education fail to achieve and the quality of internship education is not assured;

D. *Shortage of Internship Education Faculties*

The internship employers could not provide guidance on the students that match the requirements expected by the university. While most of the young teachers are proficient in theoretical research, but they cannot provide suitable practical education, which compromise the quality of internship education;

E. *Assessment on Internship Education is Superficial*

Final assessments on students' internship education are performed by evaluating the internship notes and reports which are perfunctory written by students. This method encourages

students to form a negative impression on the summary of practical education, which greatly the education' solemnity.

III. SPECIFIC SOLUTIONS

After years of exploration and practice, we proposed three aspects on our electronic engineering majors' practical education: "view", which means to understand majors' characteristics and requirements through introduction internship; "do", which means to study the fundamental skills of professional fields; and "think", which means to cultivate students' realization to serve the society with their learned knowledge and to further improve their professional skills.

A. *Clarify Objectives and Establish a Mutual, Beneficial Relationship between the University and the Internship Employers*

The functions and outcomes of practical education are clarified according to the training objectives of engineering application-oriented students. We created a uniform plan for introduction internship, production internship, and graduation internship to clarify their education objectives and requirements, respectively. Practical education is designed to be correlated and supplemental to curriculum education.

Introduction internship introduces the professional fields according to students' major. Students obtain a perceptions on their major through introduction internship, which further help to establish professional concepts and professional values. Students are instructed to actively contact the society, to integrate theory and practice, to cultivate basic professional capabilities, and to stimulate interests on their majors.

Production internship enables students to have a comprehensive realization of industry environments and equipment, technology, management and culture in production process after firmly comprehension of professional, theoretical knowledge. Students are required to have a basic comprehension of general knowledge and skills in the production process and to understand the necessary knowledge, ability, and quality requirements in positions related to their major. Students should systematically understand the application of professional knowledge in industries and enterprises, and further improve their capabilities to integrate theory and practice as well as to analyze and solve actual problems.

Graduation internship is designed to help students to discover problems, to collect relevant technical data of graduation project, to obtain the references on actual problem solution in engineering field, and to further utilize professional knowledge learned through practice, which will establish the foundation for students' successful completion of graduation design.

We perform multiple approaches to establish internship training bases inside and outside campus in order to accomplish an internship education system that contains university, internship training bases and industries. Practical education is supervised by the university and participated by industries to establish a complete route of engineering ability training.

B. Implement an Practical Education Model Combines Practice and Theory, University and Industry

- Introduction internship inside and outside campus to cultivate (students') professional interests

Improve students' perceptual comprehension by combining off-campus touring on industries with on-campus education. By introduction of the education plan of the university and visit on the laboratory, we improve comprehension and cultivate interests on students' major. Students are instructed to understand the technological theory behind products and corresponding professional courses. Students should be familiar with the professional courses and practical education related to the requirements of corresponding knowledge, capability, and quality for primary technical positions. By arranging students to consider and establish their own plans of education and training, we help students to comprehend their major and to clarify their target of future efforts, and to establish their development blueprints by the professional enthusiasm obtained through introduction education.

- Joint production internship to cultivate fundamental professional skills (of students)

Production internship is mainly performed in internship training bases and qualified internship employers. The objective focused on "do", which means that students must complete their required projects by themselves. The purpose is to cultivate students' fundamental professional skills and professional qualities.

Production internship is jointly completed by the university, the internship training bases, and the internship employers, which is supervised by the university, performed in the internship training bases, and participated by the internship employers. The joint education utilizes the advantages from above three participants and achieve mutual benefits for both sides.

In the joint production internship, the university concentrates on the training students' professional capabilities system, which undertakes the planning, design and organization of the practice in electronic information industries and is responsible for the seamless connection between the training contents, training projects, and education system of IT training companies. At the school stage, relying on well-designed comprehensive design practice projects that embody professional connotation and key technologies, and utilizing in-school training and laboratory resources, we can solve the problems of professional core competence training and engineering innovation ability training.

The electronic information enterprise undertakes the production practice of the relevant specialties of the school, focusing on the production site technology, technology, equipment, management and enterprise culture, so as to familiarize students with the process, technology and quality control of large-scale production, and to cultivate the basic quality of hard-working workers.

The internship base is responsible for the technical development and training of hot IT posts related to specialty

and job-hunting guidance for related posts. The content of technical training is decided by universities and IT training companies. Its basic principle is to carry out relevant content under the framework of professional knowledge system and competency structure, in line with the idea of checking and filling gaps, consolidating and improving weak links, and continuing to strengthen and upgrade. Make IT training content and school teaching content complement each other, promote each other, students' professional ability can be greatly improved again.

The three-dimensional co-education mode of production practice effectively exerts its respective advantages: systematic learning and training of school's focusing ability practice of enterprise's undertaking basic vocational skills and vocational quality, and professional training company's market urgently needs professional related vocational skills training. This will promote the formation of students' professional core competence and professional competitiveness, ensure that students form effective professional competence in the short term, and actively promote students' high-quality employment.

- Finding Problems in Graduation Practice and Cultivating the Consciousness of Serving the Society

Graduation practice insists on going out, once again understanding the needs of industry and enterprises, recognizing society and finding problems, improving the ability to solve specific problems by using the knowledge learned, and cultivating the awareness of serving the society.

C. Creating a Teacher Team of Practice Teaching with the Combination of Specialized and Part-time Education and the Complementarity of Schools and Enterprises

The success or failure of internship lies in teachers.

To set up a team of guidance teachers consisting of senior teachers, young teachers and enterprise technical experts, each taking its own advantages, and at the same time to train students' practical ability, to speed up the strengthening of young teachers' practical ability.

In-school teachers mainly solve related knowledge and theoretical problems. Out-of-school tutors are responsible for introducing practical knowledge and skills of enterprises, and give explanations and explanations for practical problems encountered in the process of practice.

Most young teachers in schools lack practical experience. In response to this situation, the College has implemented the "grass-roots practical training" plan for young teachers, the "summer engineering practice" plan for young teachers, and the "special support for experimental technology in the college" plan for young teachers. And actively organize young teachers to participate in a series of teacher construction activities such as Shaanxi Teachers' Electronic Competition, backbone young teachers' electronic technology training, and enrich young teachers' engineering practice experience. At the same time, with provincial famous teachers as the core, relying on the implementation of scientific research team projects, play a role of transmission and guidance, promote the rapid upgrading of young teachers' technical level, and quickly build a reasonable structure of "double-qualified" teachers.

D. Implementing the Way of Financing Practice Funds with School-based and Enterprise-based Reduction and Exemption

Practice funds are mainly allocated by schools. At present, the three major internship funds reach 1500¥ per student, ranking in the forefront of Shaanxi universities. At the same time, we strive for the preferential treatment and exemption of internship enterprises, as well as the sponsorship of some enterprises, to ensure the smooth progress of the internship process.

E. Exploring the Examination Method of Practice Teaching with Multidimensional Observation and Comprehensive Evaluation

Change the previous assessment methods which focus on attendance forms and practice reports, and explore the comprehensive evaluation from the three dimensions of knowledge, ability and quality. According to the ability requirement of enterprises for engineering application-oriented electrical professionals, a comprehensive assessment scheme based on the concept of integrating theory with practice is designed and implemented. Its structure is shown in the Fig. 1.

Knowledge assessment pays attention to the assessment of students' knowledge mastery in practice teaching content. Students are required to use their knowledge to analyze, explain and calculate the problems encountered in their practice. Ability assessment pays attention to the situation of completing the practice teaching task in prescribed time. It also pays attention to the assessment of practical skills, engineering design and development and implementation ability, and field-oriented application ability to solve specific problems. Quality assessment is to assess students' performance, the quality of submitting reports, the logic of presenting presentations, the effect of physical presentations and other professional qualities, personal accomplishments and necessary team spirit in the process of practice teaching.

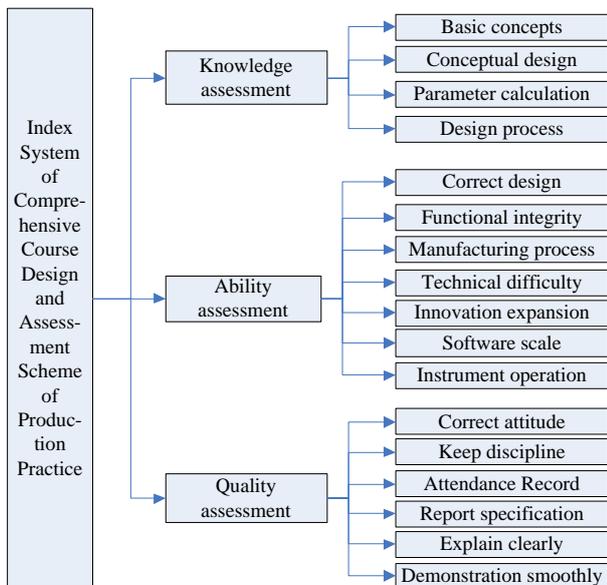


Fig. 1. The assessment scheme of production practice.

Assessment method is not only a means of inspection, but also a guiding tool. This assessment method promotes teachers and students to improve their understanding of the importance of practice teaching, and promotes the steady improvement of the quality of practice teaching.

IV. CONCLUSIONS

Based on the analyses of the current status and problems of practical education, the functions and outcomes of practical education are clearly described according to the training objectives of engineering application-oriented students. We created a uniform plan for introduction internship, production internship, and graduation internship to clarify their education objectives and requirements, respectively. We establish a practical education system which is jointly completed by the university, the internship training bases, and the internship employers and to implement a practical education model combines practice and theory as well as university and industry. We have practical education faculties includes experts and generalists from the university and the industries. We implement a method to obtain internship education funding mainly through university sponsorship with complimentary support from the industries. We explore the assessment method on internship education outcomes through three aspects containing (students') knowledge, capabilities, and qualities, which guarantees the smoothly progress of the internship education and improves the quality of practical education. Our exploration on practical education received

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