Research and Practice on the Practice Teaching System of Engineering Majors in Applied Undergraduate Universities

Yi-huo JIANG¹,a and Long-tian FU¹,b

¹FuZhou University of International Studies and Trade, Fuzhou, Fujian, China,
a34254141@qq.com; b253601337@qq.com
*Corresponding author

Keywords: Application Type; Engineering; Practical Teaching.

Abstract. Deepen the integration of production and education, highlight practical innovation, and build an engineering practice teaching system of “five in one, school-enterprise collaborative education”. The engineering practice teaching system runs through the whole process of professional talent training, and the closed-loop practice teaching system consists of five parts: goal, content, management, guarantee and evaluation. The system has achieved good results in the practice of talent training in software and information majors, and has trained a group of high-quality IT application talents to provide reference for the reform of the practical teaching system for building high-level applied universities.

Introduction

The National Development and Reform Commission, the Ministry of Education, and the Ministry of Human Resources and Social Security jointly issued the Notice on the Establishment of the "13th Five-Year Plan for the Integration of Production and Education Development Projects" (Development and Reform Society [2016] No. 547), pointing out During the five-year period, the application-oriented undergraduate education and integration project was implemented, and a number of national high-level applied universities were established. The perfect engineering practice teaching system plays a key role in cultivating high-quality applied talents. The innovation reform of the practical teaching system is one of the key points in the reform of engineering education in applied undergraduate colleges. This paper takes the application-oriented undergraduate software information major as a pilot, deepens the integration of production and education, highlights the practice and innovation, and builds a practical teaching system for engineering undergraduate colleges in the five-in-one, school-enterprise collaborative education (referred to as engineering practice teaching system).

Current Situation of Practical Teaching of Engineering Majors in Applied Undergraduate Colleges

In applied undergraduate colleges, practical teaching is an important teaching link in the process of cultivating engineering professionals. A perfect practical teaching system is the key to cultivating innovative spirit and engineering practice ability. It is necessary to build high-level applied universities and cultivate high-quality applied talents. It plays a vital role. However, most of China's applied universities are transformed from traditional local undergraduate colleges, or newly established private undergraduate colleges, lacking experience in research and practice of applied talents.

In terms of theoretical research, most scholars mainly propose strategies and measures to optimize practical teaching from the micro level. There are mainly scientific and systematic not strong, fragmentation of content and learning process, and the combination of teaching content setting and practice cognition is not high. The implementation of the specific operational level of teaching reform is not in place. In terms of personnel training practice, some colleges and universities still adopt the old model; some try to reform, but there are problems such as the disconnection between
theoretical teaching and practical teaching, the lack of teaching guarantee measures, and the lack of practical teaching teachers. At present, most applied colleges and universities are far from the teaching goal of cultivating high-quality applied talents and improving students' practical and innovative ability. Therefore, it is of great significance to increase the research on the engineering practice teaching system and apply the research results to the practice of engineering professional talents training for the cultivation of high-quality engineering application talents.

The Overall Structure of the Engineering Practice Teaching System

This paper adopts a systematic idea to reform the practical teaching system in order to solve the main problems faced by practical teaching in applied undergraduate universities. The engineering practice teaching system is a new mode, which closely focuses on the "high-quality, application-oriented, engineering" talent training objectives of engineering-based undergraduate engineering, pays attention to the cultivation of engineering practice and innovation ability, according to the requirements of practical cognitive rules. In accordance with the engineering cognitive ability training, engineering experiment ability training, engineering design ability training, engineering implementation ability training, engineering practice and innovation ability training, the construction of engineering ability training path and practical teaching content system, focusing on "school-enterprise Collaborative, five-in-one" education characteristics, enterprises participate in the whole process of talent cultivation. The whole engineering practice teaching system consists of five sub-systems: practice goal, practical content, practice management, practice guarantee and practice evaluation, forming a closed-loop practical teaching system. The teaching goal system focuses on engineering innovation practice ability, the teaching content emphasizes practical application, the teaching management emphasizes the practice process, the teaching guarantee strengthens the school-enterprise collaboration, the teaching evaluation pays attention to diversification, and each sub-system is continuously improved and improved in the running process.

The Composition of Engineering Practice Teaching System

Establishing a teaching target system for engineering practical ability training

With reference to the requirements of engineering professional certification, starting from the needs of engineering talents, the training practice and innovation ability as the main line, the teaching objectives are set around the three levels of consciousness, literacy and ability, and the engineering practice teaching target system is formed.
1. Engineering Awareness Level: From the five aspects of cooperation, quality, practice, responsibility and innovation consciousness, combined with the corresponding professional characteristics to develop engineering awareness teaching objectives.
2. Engineering literacy level: According to the needs of engineering talents, the quality of craftsmanship from communication, organization, management, observation, learning and analysis, dedication, collaboration and so on.
3. Engineering capability level: Starting from the needs of engineering practice, combined with professional practice, from the aspect of engineering design, implementation, maintenance and innovation, formulate the ability goal of engaging in engineering practice activities.

Establish a teaching content system that emphasizes practical application

According to the requirements of engineering practice teaching objectives, the practical teaching content should be integrated into the whole process of personnel training. According to the practice and cognitive rules, an advanced practical teaching content system consisting of cognitive, experimental, design, implementation and innovation links is constructed. As shown in Table 1, taking an application-oriented undergraduate software information development class as an example, five practice links are set according to the law of practice cognition, and a practical teaching content system with progressively improved engineering capabilities is formed.
Table 1. The composition of the practical teaching links of software and information majors in an applied undergraduate college.

<table>
<thead>
<tr>
<th>Teaching session</th>
<th>Learning tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering cognition Ability</td>
<td>In the first semester, arrange to visit and learn from the company, listen to the seat, understand the corporate culture and enterprise management system, and learn the professional introduction, career planning and other courses, familiar with the job classification and corresponding job ability requirements, and enhance the engineering cognitive ability.</td>
</tr>
<tr>
<td>Engineering experiment Ability</td>
<td>At the end of the 1-4th semester, each session will be arranged for 1-2 weeks, which is used for the practical teaching of the core curriculum of the practical teaching system (6) to cultivate students' basic professional application ability. Train engineering experimentation skills by participating in basic competition projects.</td>
</tr>
<tr>
<td>engineering design Ability</td>
<td>In the 5th and 6th semester, it will be arranged for 2 weeks to complete the small project development training (one for BS and CS projects) to cultivate students' project thinking and special skills. Cultivate students to become the backbone of professional associations, conduct project training under the guidance of teachers, undertake the activities of science and technology competition festivals, participate in small project development competitions, and focus on cultivating engineering design capabilities.</td>
</tr>
<tr>
<td>Project implementation Ability</td>
<td>In the 5th and 6th semester and summer vacation, we will set up practical courses, arrange 4-5 months of comprehensive project training, develop practical training projects according to the actual development process of the enterprise, and select outstanding students to participate in the disciplines or The software development competition mainly focuses on engineering implementation capabilities such as student teamwork, professionalization and comprehensive project development.</td>
</tr>
<tr>
<td>Engineering practice and innovation Ability</td>
<td>Arrange the 7th and 8th semester, enter the enterprise to participate in the actual project development, implement the dual tutor system, complete the graduation internship and graduation design teaching links, and organize students to participate in the Internet +, innovation and entrepreneurship competition and other innovative practice activities to cultivate students' engineering practice and innovation ability.</td>
</tr>
</tbody>
</table>

Strengthen the coordination between schools and enterprises, and build a support system for practical teaching

Ensuring that practical teaching objectives are achieved and all aspects of practical teaching are implemented, a strong teaching support system is the key. Most applied undergraduate colleges are alone in combat, and it is difficult to provide teaching resources and conditions that meet the needs of practical teaching. Deepen the cooperation between schools and enterprises, and comprehensively educate people. From the five aspects of curriculum system construction, teaching resource development, practice platform construction, teaching process implementation and teacher joint training, optimizing the allocation of school-enterprise resources is the cornerstone for the goal of ensuring the application of talents. As shown in Table 2, we have deep cooperation with...
ChinaSoft International (Xiamen), Fujian Nanwei Software, Xiamen Bowenwensi and other enterprises to build a practical teaching support system for software and information majors. Schools and enterprises cooperate with each other to participate in personnel training.

Table 2. Practical Teaching Support System for School-enterprise Collaboration.

<table>
<thead>
<tr>
<th>Collaborative project</th>
<th>work tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curriculum system construction</td>
<td>Based on the systematic approach of work process, the core curriculum system of practical teaching is constructed. Through research, according to the content requirements of the practical teaching system, set up corporate cognitive internship, career planning, core professional practice courses (6), individual skills competition, innovation and professional quality practice, project short training, practical topic production, comprehensive project training, graduation design, production (graduation) internship and other links to the practical teaching system.</td>
</tr>
<tr>
<td>Faculty construction</td>
<td>With the establishment of a certain scale and good development trend (such as: ChinaSoft International (Xiamen), Fujian Nanwei Software, Xiamen Boss Wensi, Xiamen Touch Technology) and other enterprises to jointly cultivate the &quot;double-master dual-energy&quot; faculty, established A teaching team with rich teaching experience and strong practical ability.</td>
</tr>
<tr>
<td>Practice platform construction</td>
<td>Established an on-campus training factory with Xiamen DiAO Company and Nanwei Company; established a productive training base with Xiamen Diao Company; established a school outside with more than a dozen companies including ChinaSoft, Xiamen Touch, Nanwei Software and Fujian Chuanyi. Practice teaching base and college students' innovation and entrepreneurship base.</td>
</tr>
<tr>
<td>Teaching resource development</td>
<td>Cooperate with ChinaSoft International, Fujian Chuanyi, Xiamen Wanze Zhiye and Xiamen Diao to develop .NET project development, JAVA project development, Web front-end development training materials and experimental instruction books to achieve the interface between teaching content and professional standards.</td>
</tr>
<tr>
<td>Teaching process implementation</td>
<td>The company participates in the professional practice teaching process in the whole process. In the first 3 years, some enterprise engineers are taught in the school. In the 4th year, the students enter the enterprise learning mode. The practical teaching links are basically completed by the school and the enterprise to realize the teaching process and production. Process docking.</td>
</tr>
</tbody>
</table>

Establishing an engineering practice teaching management system with outstanding processes

The long-term stable and orderly operation of the practical teaching system and the supporting teaching management system are the key. The scientific and perfect practical teaching system mainly includes three aspects: organization, system and operation management. Most application-oriented undergraduate colleges can do a good job in organizational and institutional management, but there are many deficiencies in operational management. The quality of operation management directly determines the effectiveness of practical teaching management. With reference to the overall quality management theory, a PDCA closed loop consisting of planning, execution, process and feedback adjustment is established.
1. Program management includes overall planning and execution planning. The overall plan refers to the objective requirements of practical teaching and the overall design and arrangement of the practical links. The executable plan developed in each specific practice step of the implementation plan is embodied in the plan (teaching goal, teaching content design and schedule), instruction book and task book for each practice session.

2. Execution management refers to the process record of implementing a practical teaching link, mainly examining the recording materials of the implementation process, including the teacher's guidance record and the staged record of the student training.

3. Process monitoring refers to monitoring the practice of educational administration, the teaching process of teachers and the learning process of students, and assessing the standardization level, teaching level and learning effectiveness of educational administration.

4. Feedback adjustment. Practical teaching management feedback consists of daily feedback and special feedback. Daily feedback refers to regular feedback based on the results of daily inspections. Special feedback refers to feedback on the inspection of important aspects of practical teaching according to the corresponding evaluation index system. In order to ensure the quality of practical teaching, it is required to timely adjust and optimize the problems existing in daily feedback and special feedback.

Establish a diversified engineering practice teaching evaluation system

Objective and accurate teaching evaluation has the guiding function of promoting the improvement of teaching quality. The scientific evaluation of the practical teaching system is a necessary link to establish a sustainable high-quality application of talents. Teaching evaluation itself is a complicated process. It is necessary to continue science. This study establishes a practical teaching evaluation system based on the background, investment, process and effectiveness of the CIPP evaluation model 4, which was first created by Stavreby. The evaluation contents are shown in Table 3.

Table 3. Diversified engineering practice teaching evaluation system.

<table>
<thead>
<tr>
<th>Evaluation project</th>
<th>comment content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background evaluation</td>
<td>1 The rationality of the teaching objectives; 2 The degree of recognition of the teachers and students on the practical teaching system; 3 The familiarity of the cooperative enterprises with the practical teaching system; 4 The matching of professional strengths to the practical teaching requirements;</td>
</tr>
<tr>
<td>Input evaluation</td>
<td>1 practical teaching funding; 2 cooperative enterprises' willingness to cooperate; 3 teaching platform facilities and equipment; teaching resources development; 4 practice teaching staff.</td>
</tr>
<tr>
<td>Process evaluation</td>
<td>1 organizational executive power; 2 the degree of perfection of the system; 3 the fit of the plan and the target; 4 the implementation of the teaching link; 5 the teaching support in place; 6 process standardization; 7 teacher and student input; 8 teaching link assessment normative.</td>
</tr>
<tr>
<td>Performance evaluation</td>
<td>1 practical ability assessment and certification; 2 engineering practice competition awards; 3 graduate employment quality; 4 engineering practice innovative works</td>
</tr>
</tbody>
</table>

Practice of Engineering Practice Teaching System

The research on the practical teaching system of the project began in 2013, and cooperated with IT companies such as ChinaSoft International (Xiamen), Nanwei Software, Beijing Anbo, and Xiamen Bowenwensi to jointly build software engineering and jointly implement the engineering practice teaching system. The main work process is as follows:
Systematic analysis of work process and construction of core curriculum system for practical teaching

Through the investigation of the status quo of the talent structure of the industry enterprises and the demand for talents, the orientation of professional talents is determined. Then, the typical tasks of the graduates are investigated and analyzed, and the talent growth process and the knowledge ability requirements of different stages are summarized. Carry out the transformation of the learning field, build the core curriculum system of the practical teaching of the talent cultivation process, and realize the docking of professional practice and job skills.

School-enterprise professional construction, to create quality practical teaching conditions

Engineers from strategic cooperative enterprises send teachers to the school to improve the teaching level. The school sends teachers to the company to improve their practical ability and cultivate high-quality "double-skilled dual-energy" teaching team. School teachers and enterprise engineers jointly develop practical teaching resources to ensure the advanced nature of teaching content and post adaptability, and to achieve the interface between teaching content and professional standards. School-enterprise cooperation in the construction of laboratories, training rooms, professional club activities, entrepreneurial bases, construction of productive training bases in Xiamen Software Park, to create conditions for the realization of the teaching process and production process docking.

Participate in many parties and jointly implement the engineering practice teaching system

The practical teaching system implements the “3+1” teaching mode, that is, the first four links are completed in the first three years, and the last one is completed in the fourth year. Through cooperation with a number of software companies in Quanzhou and Xiamen, the company sends engineers and teachers to undertake the practical teaching tasks of professional cognition, professional associations, skill competitions and project training for the first three years. In the fourth year, students enter the enterprise to learn. Introduce the AMB CCEP professional literacy project, implement the “double tutor system” to complete the practical teaching activities such as graduation design, production internship and entrepreneurial competition, cultivate students' professional practice innovation ability, and do a good job in job recommendation service.

The engineering practice teaching system was successfully applied to the training of software engineering professionals in a university. Among the three students in the pilot, the employment rate averaged over 98%, the professional counterpart rate reached 80%, and the signing rate and average salary ranked first in all majors in the school. It has trained more than 500 software engineering excellence engineers urgently needed in the development of the IT industry. According to the survey of employer satisfaction, students trained in the practical teaching system are generally well received by employers and institutions.

Conclusion

Under the background of the country's vigorous promotion of the construction of high-level applied universities, it is of great significance to study the application-oriented university engineering professional practice teaching system that highlights the integration of production and education and the practice of innovation. The integrated engineering practice teaching system constructed in this paper is practiced in the software engineering and information management profession, and the results are not borrowed, but there are still many places that need to be improved. The research and practical experience of the article can provide reference for the practical teaching reform of engineering majors in applied universities.
References


