Exploration and Practice on the Model of Industry-Education Integration for Computer Majors—Take Electronic and Computer Engineering Major of Southwest Petroleum University for Example

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ABSTRACT

The industry-education integration is the basic path for the transformation and development of local applied universities. Taking Electronic and Computer Engineering major of Southwest Petroleum University as an example, this paper explores and practices the integration of industry and education in computer majors and summarizes the education model of industry-education integration based on industrial colleges, the industry-oriented curriculum system construction, the construction of industry-education practice center and “double-qualified teacher” faculty, the governance structure and management system. It provides reference for the applied universities to implement the industry-education integration and make school-enterprise cooperation gradually achieve the goal of win-win.

1. INTRODUCTION

The current cultivation model of computer professional talents in China is not well adapted to the needs of innovative talents in the industry. Traditional teaching methods are still generally adopted. The students’ practical and engineering project ability is not strong and there are some difficulties for them to adapt to the requirements of enterprise employment after graduation[1]. The lack of cross-disciplinary knowledge is not conducive to cultivating students’ comprehensive ability to analyze and solve problems [2]. Adopting the mode of industry-education integration is critical for cultivating computer professionals in the new economy.

The industry-education integration has established a relatively complete legal guarantee system, operation and practice mechanism in some countries, such as
Germany’s “dual system”, Australia’s “cooperative education”, the United States’ “school-enterprise cooperation”, and the British “sandwich” [3]. Some scholars have suggested that schools should rely on school-run enterprises to provide practical bases and internships for teachers and students [4][5]. The school-enterprise cooperative education model in the engineering field strengthens the “three-in-one” partnership between schools, enterprises and students, and provides “work-ready” students for the industry [6].

In China, industry-education integration is an important path to realize the integration of the education and industrial chain, the talent and innovation chain [7]. More and more applied universities explore and cooperate with enterprises to build a joint industrial college as a platform of industry-education integration.

In 2016, based on a number of researches, demonstration and discussion, Southwest Petroleum University (SWPU) and Zhuhai Shiji Dingli Technology Co., Ltd. (Shiji Dingli) finally chose two majors: Electronic and Computer Engineering, Information Management and Information System to cooperate and jointly established the industrial college-Dingli College. Taking the first major as an example, the paper analyzes and summarizes the integration mode and experience to cultivate computer professionals.

2. EXPLORATION AND PRACTICE

2.1 UBL Talent Cultivation Model

The essence of the transformation and development of applied universities is the reform of talent cultivation mode [8]. Dingli College adopts UBL (Ultra wise Blended Link) talent cultivation mode which links the “industrial clouds” and the “education cloud” through “introducing standards, relying on bases, undertaking projects, and mixing learning” to build a super-hybrid talent ecosystem [9].

UBL is based on CDIO engineering education mode[10] [11] and OBE idea [12] divides talent training into four stages and respectively through “task-driven, case-driven, project-driven, post-driven” teaching modes to enhance students’ competence systematically and gradually realizes the “knowledge integration, skill integration, and post integration” (Figure 1). The model helps to realize the seamless connection between talent cultivation and industrial needs.

![UBL Talent Cultivation Model](image-url)
2.2 Industry-Oriented Curriculum System

2.2.1 THE RESEARCH AND ANALYSIS OF INDUSTRY DEMAND

SWPU and Shiji Dingli made a research and analysis of industry demand, including the industry technical status, development trends, talent needs, typical positions, job responsibilities and requirements, assessment criteria, etc.. Competency models are made to guide the cultivation goals and requirements.

Through the analysis of market prospects and job requirements in the embedded and Android technology fields, two professional directions have been established: embedded development direction and mobile Internet development direction. According to the Gartner survey, Android accounts for nearly 86% of the operating systems installed in smartphones sold in 2017-2018 (Figure 2). China Information and Communication Research Institute shows that more than half of the companies plan to increase their investment in embedded through the projected trend of embedded investment in the future (Figure 3).

Figure 2. The percentage of operating systems installed in smartphones.

Figure 3. Enterprises expect future embedded investment trends.
2.2.2 CURRICULUM SYSTEM CONSTRUCTION

In order to address academic and local industrial needs in a unified way, it is necessary to design one curricula system that highlights theoretical understanding, experience and skills development [13]. Through the analysis of the typical task of the positions, the knowledge, competency and literacy units are determined. A number of units form a course and if there are more knowledge units spanning the competency units, they are designed as comprehensive practical courses. The common requirements of the positions on knowledge and ability can be classified into professional basic and core courses. The personality requirements of the positions can be classified into direction and elective courses.

Combined with the curriculum structure of SWPU, the curriculum system was jointly constructed, including General Knowledge Module, Discipline Foundation Module, Professional Foundation Module, Discipline Module, Professional Module and Second Classroom. The last two reflect the characteristics of school-enterprise cooperation (Figure 4). Online training, short semester training and comprehensive training are systematically designed. According to the status of the courses, Massive Open Online Courses (MOOCs) were developed to help students improve professional practice [14] [15]. The professional talent cultivation plan is updated periodically according to the industrial development needs.

2.3 Practice Center of Industry-Education Integration

The reform of industry-education integration needs a solid transformation platform. Schools and enterprises should jointly invest in the construction of a systematic and practical practice center with real occupational environment [16].

In 2016, “Mobile Internet Engineering Practice Center” was jointly established which includes Mobile Application Development Engineering Practice Center, Embedded Development Engineering Practice Center and Big Data Cloud Computing Engineering Practice Center. Each center has the technical support of the leading enterprises, the training project, and the decoration design according to the real working environment, so that the students can quickly enter the state of “professional people”.

Figure 4. Professional Module and Second Classroom Curriculum System.
2.3.1 THE INTEGRATION OF TEACHING, LEARNING AND PRACTICING

Most engineering students may not be proficient at solving project-based problems that require systematic learning strategy, innovation, problem-solving, and execution [17]. Practice teaching emphasizes “learning through practicing” with case-driven and project-driven teaching to solve practical problems and to guide students to take the initiative to learn.

The relevant industrial technology and business process were developed into simulation training cases. Students entered the cases in the form of role-playing under the guidance of the project manager. International industrial projects suitable for the students are introduced and the management norms and systems of the top 500 enterprises are injected. Students can establish good professional quality and ethics, and complete the transformation of social people to professional roles.

2.3.2 THE INTEGRATION OF SCHOOL AND ENTERPRISE

The pre-sequence courses adopt the "big engineering" education idea that dilutes the professional boundary. Teachers of the university can teach the lecture and the enterprise can provide expert lectures, technical seminars, and disciplines competitions, semester training and other services. Application-oriented courses can improve application development capabilities while learning further theoretical knowledge and they be jointly implemented. Training case courses are based on training platforms which can improve the project development abilities and can be jointly implemented.

2.3.3 THE INTEGRATION OF PRODUCTION, LEARNING AND RESEARCH

According to the requirements of industry-education integration and school-enterprise cooperation, the Practice Center has become the teaching base and research project development base for training high-quality skills and applied talents in SWPU. The practice center is divided into two functional areas according to functions. One is used for engineering practice teaching, and undertakes basic teaching such as professional teaching and training. The other one is used for actual industrial projects, and real industry outsourcing projects are introduced through industry manufacturers.

2.4 Double Qualified Teacher

The construction of the teaching staff is the key to improve the quality and level of education, and it is also an important starting point for promoting industry-education integration. There are two methods to build the double qualified teacher team. Firstly, introduce enterprise engineers to teach the students. Secondly, invite industry experts to guide and train the teachers of the college, introduce new technologies and new ideas, jointly study the reform methods of education and teaching, jointly develop curriculum resources, etc., and to promote the improvement of teachers' teaching and research level.
2.5 Organization and Management Mechanism

School-enterprise cooperation must continuously acquire and apply advanced management ideas and methods to achieve the goal of win-win. SWPU and Shiji Dingli formed the board of directors of Dingli College, the highest decision-making body of Dingli College. The ISO9001 management system suitable for school-enterprise cooperation has been established which can promote the standardization, institutionalization, scientific and programming of the quality management system. The responsibilities are clear and ensures the traceability of responsibilities. Management and quality awareness of school and enterprise faculty has been also improved [18].

3. RESULTS AND ACHIEVEMENTS

3.1 Improved Innovation and Entrepreneurship Ability

Dingli college builds an innovative and entrepreneurial competition platform, enterprise engineers and experts are invited to guide students. Since the school-enterprise cooperation, Dingli College students won one silver medal in "ACM International College Student Programming Competition" and 6 prizes in the "Blue Bridge Cup National Software and Information Technology Professionals Competition".

3.2 Improved Teaching and Research Capabilities

During the cooperation, Dingli College teachers applied for a number of research projects in the field of school-enterprise cooperation, collaborative education programs, integration of industry and education, and work-study training model. Case teaching courses are jointly developed, reforms are implemented in teaching modes such as mixed teaching, flipping classrooms, and teaching integration, which improved the teaching ability of teachers and improved the quality of talent cultivation.

3.3 The Ecosystem of “Co-Creation, Symbiosis and Win-Win”

The mode of industry-education integration can bring different benefits to society, industry, colleges and students, and it is conducive to the formation of the "co-creation, symbiosis, and win-win" ecosystem. The standard of professional education and industry standard is unified, the teaching content is unified with the actual application, and the education, talent, industrial and innovation chain are integrated. Dingli College has signed internship cooperation agreements with dozens of typical companies which provide internship and employment security. In addition to acquiring knowledge and professional skills, students receive 0.5-1 years of real industry experience and continuous employment competitiveness during their studies. The college has optimized the structure of the teaching staff, improved the teaching and research capabilities of teachers. Dingli College has been highly appraised by the expert group and the government in the undergraduate audit evaluation, which can enhance the competitive advantage and brand influence of the university.
4. CONCLUSIONS

The development prospects and organizational vitality of the Industrial College have made the local applied universities have a better vision, and we need to constantly explore and promote them. Southwest Petroleum University actively adapts to the development of new industries and technologies, and explores the industry-education integration and school-enterprise cooperation. The computer majors’ construction which are rely on the Dingli College reflects the industrial characteristics and makes a series of achievements. But there are still a series of problems that need to be continuously studied and exploration, such as the industry-led cooperation model of the Industrial College under the new situation, the synchronization of the dual-qualified teacher training with the rapid development of the industry and technology, and the reform of the school-enterprise mixed teaching model. We will continue to explore and summarize in the practice of industry-education integration, promote the development of school-enterprise cooperation to the stage of common development and industry leadership, and further enhance the ability to serve the transformation and development of regional economy and industry.

REFERENCES

1. Xiong, S.W., W.B. Rao, J. K. Yuan, P.F. Duan. 2017. “Exploration and Practice of the Practice and Innovation Ability Model of Computer Professionals in ‘Three Collaboration and One Intersection’,” Software engineering, 20(7):12-14.
2. Zhang Q.S., 2018 “Research on the Cooperative Education Mode of Computer-based Professional Schools and Enterprises under the Background of New Engineering,” Software Guide (Educational Technology), 17(11):69-71.
3. Ren J.G, Q.Q Wu, Z.Z Han, G.Ke, D.S.Wang. 2018. “Research on the Education of Industry-Education Integration for Geological Majors,” Educational Sciences: Theory & Practice, 18 (5):1315-1322.
4. Akomaning, E., Voogt, J. M., & Pieters, J. M. 2011. “Internship in vocational education and training: Stakeholders’ perceptions of its organization,” Journal of Vocational Education and Training, 63(4), 575-592.
5. David R. Cole. 2011. “Educational Life-Forms,” Sense Publishers, 109-121.
6. Kari Laine. 2015. “Open Innovation Between Higher Education and Industry”, Journal of the Knowledge Economy, (6): 589-610.
7. Li T. 2017. “Industry College: A New Path for School-Enterprise Cooperation”. Educational review, (11):27-30.
8. Zhang D. L. 2016. “Four Key Points of Ordinary Undergraduate Colleges Transforming to Application-oriented Colleges,” Chinese Higher Education, (8):1.
9. Guan L., J.H. Liang. 2018. “Exploration and Practice of School-enterprise Collaborative Education Mode under the Background of New Engineering.” Computer Education, 287(11): 100-103.
10. Kristina Edstrom, Anette Kolmos. 2014. “PBL and CDIO: complementary models for engineering education development,” European Journal of Engineering Education, 39(5):539-555.
11. L. C. Woollacott. 2009. “Validating the CDIO syllabus for engineering education using the taxonomy of engineering competencies,” European Journal of Engineering Education, 34(6):15.
12. H J de Jager, F J Nieuwenhuis. 2005. “Linkages between Total Quality Management and the Outcomes-Based Approach in an Education Environment,” Quality in Higher Education, (11):18.
13. Q. A. Memon. 2007. “On analysis of electrical engineering programme in GCC countries,” European Journal of Engineering Education, 32 (5):551-560.
14. Trang Phan, Sara G. McNeil, Bernard R. Robin. 2016. “Students’ patterns of engagement and course performance in a Massive Open Online Course,” Computers & Education., (95):36-44.
15. Liyanagunawardena, T., Adams, A., & Williams, S. 2013. “MOOCs: a systematic study of the published literature 2008-2012,” International Review of Research in Open & Distance Learning, 14(3):202-227.
16. Li B.Y., L. Chen, M. R. Chen. 2017. “Research on the Construction of Industrial College of Applied Undergraduate Colleges in Transitional Development,” Educational review, (12):3-6.
17. K. J. Chua, W. M. Yang, H. L. Leo. 2013. “Enhanced and conventional project-based learning in an engineering design module,” International Journal of Technology and Design Education, 24 (4):437-458.
18. Guan L., Y. Bao, J.H. Liang, Q. Y. Liu. 2019. “Exploration of ISO9001 Management System Construction in Diversified Ownership Industrial Colleges,” Vocational Education Research, (5): 42-47.