A Research on ICT Curriculum Co-construction under the Framework of School-enterprise Cooperation

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Abstract. The rapid changes in ICT technology have made it necessary for industry talents to constantly adapt to technology updates, and meanwhile, continuous integration and collaboration of business further strengthen the comprehensive requirements for talents. Application-oriented colleges and universities guided by vocational needs and based on engineering scene, need to carry out teaching design, aiming at developing professional job skills in line with market demand. The core content of the curriculum co-construction of school-enterprise cooperation includes the construction of practical talent training system, related standard of education and teaching, faculties of “dual abilities”, high-level practice base, certification training as well as curriculum and employment docking platform. During this process, enterprises can help colleges and universities create application-oriented curricula and promote the deep curriculum transformation of colleges and universities in talent training, professional teaching, quality education and human resource service with the close connection between professional education and regional industry development, in order to achieve the ultimate goal of industry-teaching integration.

Background

Rapid Development of ICT Industry

ICT is a combination of information technology (IT) and communication technology (CT), namely information and communication technology. ICT covers industries such as communication, electronic information and the Internet. It can offer a variety of services based on broadband and high-speed communication network, and is the transmission, sharing and application of information. In the era when digital economy boosts the rapid development of global economy, a new generation of ICT technology represented by 5G, Internet of Things, cloud computing, big data and artificial intelligence, has become one of the most active areas of innovation, and is the core engine that drives social and economic transformation and upgrading. In the context of continuous network evolution, technological innovation and upgrade as well as the increasingly enriched applications, ICT technology is infiltrating into all walks of life, accelerating the integration and development with the real economy. Business deployment will be generally clouded, and Internet of Everything, ubiquitous intelligence and virtual-real combination will be everywhere. Therefore, ICT industry needs a large number of complex talents who are proficient in ICT, mastering certain management knowledge and capabilities.

ICT Industry Demand for ICT Talents

According to the research data of the China Academy of Information and Communications Technology, China's digital economy industry scale reached 30 trillion yuan in 2018, accounting for
33% of the total GDP, which has become a core component of China's economic growth. Especially with the technology iteration of cloud computing, big data, artificial intelligence and the broader industrial innovation ecosystem, various ecological members of the ICT industry are helping different types of traditional enterprises to accelerate the transformation and upgrading of the “Internet Plus”.

Based on the online big data analysis of the National Bureau of Statistics, the Ministry of Education and some online recruitment enterprises, in 2018, the total demand for ICT industry talents is 8.07 million, and it is expected to reach 12.46 million by 2020. Moreover, with the accelerating industrial digital transformation, the demand gap of ICT talents is still being widened continuously, and challenges in area, structure and business of ICT industry talents will become increasingly severe in the future.

The rapid changes in ICT technology have made it necessary for industry talents to constantly adapt to technology updates, and meanwhile, continuous integration and collaboration of business further strengthen the comprehensive requirements for talents. However, for the unbalanced development of ICT engineering education in colleges and universities, there are many existing problems. Education is out of touch with the ICT industry. Practice teaching, engineering curriculum design and graduation design are seriously insufficient. The curriculum system of engineering curriculum is relatively obsolescent and incompatible with the adjustment and development of China's industrial structure. Conditions of school operation cannot be improved owing to serious shortage of investment, and the quality of engineering education is severely affected for faculties of ICT engineering education are generally short of engineering experience. It is necessary to establish a guarantee system for ICT engineering education quality.

Literature Review

Pan Maoyuan and Shi Huixia suggest that practical talent is a type of talent training in university. The main task of the university is to cultivate and train professional practical talents, and contents of curriculum and teaching are full of practicality.

Liu Yingchun and Xiong Zhiqing point out that applied undergraduate education is a new type of undergraduate education driven by the modernization of China's economic construction and the popularization of higher education. As an independent type of education, it must have an education system consisting of talent training objective, training specification, training process, training method as well as evaluation criteria.

Li Guixia, Zhong Jianzhen and Wang Lihong put forward that a training mode of “module plus dual goals” for innovative and practical talents should be constructed. Chen Jiefang finds that higher education in China has shifted from scale development to connotation development, and application-oriented talent cultivation has become a problem that needs to be solved.

Training and Consulting Program was held in Thailand by the World Association for Cooperative Education in 2001. It outlines the basic structural framework of cooperative education, which is the tripartite cooperation of school, student and employing unit. The school serves as the organizer of the educative activities, the student as employee and the employing unit as the employer. It is obvious that cooperative education refers to tripartite cooperation, and students are very important partners, because the purpose of cooperative education is talent cultivation. The relationship between student and employing unit is that between employee and employer, which is not dominated by the school but by the market. Students are trained in a completely real social environment, which is conducive to the improvement of their comprehensive quality.
Content Design of School-enterprise Curriculum Co-construction

Construction of Practical Talent Training System

Guided by vocational needs and based on engineering scene, teaching design aimed at developing professional job skills, is carried out in line with market demand. The school and enterprise jointly formulate talent training program, incorporate new technology and new norms into teaching standard and content in time, and strengthen student internship training. Optimize the structure of talent training, and comprehensively apply enrollment plan, employment feedback, grants, standards and assessments so as to guide the school to adjust the discipline and specialty structure in time and to increase the proportion of practical, compound and technical talents.

Construction of Related Standard of Education and Teaching

According to the docking requirements between curriculum setting and industrial demand, between course content and vocational standard as well as between teaching process and production process, school setting standards should be perfected to improve teaching management and teaching practice ability. It is necessary to continuously update and promote the curriculum catalogue, curriculum teaching standard, curriculum standard, post internship standard, training condition standard and practical implementation.

Construction of Faculties of “Dual Abilities”

During the cooperation period, in order to meet the teaching requirements of curriculum courses, it is essential to assist the school to gradually improve the technical ability and practical ability of teachers by offering on-site training, summer training, business practice, and mutual teacher recruitment which are suitable for faculties and helping to enhance their teaching ability.

Construction of High-level Practice Base

Both school and enterprise jointly build a high-level vocational education training base that integrates practical teaching, social training, real enterprise production and social technology service with respective resources. The base radiates schools and enterprises in the region.

Construction of Certification Training

Relying on the strong technical strength background and the industry chain support of ICT industry, training curriculum resources and certification system are introduced to set up a training center which carries out certification training of vocational skill rating certificate for students inside and outside the school as well as social groups, in order to deepen the talent training mode of school-enterprise-production-education integration.
Construction of curriculum and Employment Docking Platform

The advantages of communication are ICT equipment manufacturing, integrated application, technology research and development such as communication, smart city and terminal. Our cooperation relies on the advantages of communication, and professional and related ICT industries including R&D, manufacturing, application, operation and maintenance, are combined, which make the relationship among talent training, enterprise need, internship and employment more transparent and closer. The ICT industry covers the sensing layer, the network layer, the platform layer and almost the entire information communication field, so that curriculum orientations of ICT School cover communication, Internet of Things, cloud computing and network security.

![Curriculum and Orientation of ICT School](image)

Figure 2. Curriculum and Orientation of ICT School.

Stage Design of curriculum Co-construction of School-enterprise Cooperation

As for undergraduate engineering education, the basic location of international engineering education certification is to cultivate the ability to solve complex engineering problems. We learn from the procedures and processes of professional engineering talent cultivation used by enterprises in the actual engineering practice, and establish a four-stage teaching structure to gradually complete the training of practical engineering talents. The initial stage is to understand the entire process of industrial engineering project as a panoramic background for engineering education. The lifting stage takes the routine tasks as the core teaching content while the reinforcement stage is driven by open issues facing engineering projects. Students in the all-round development stage must complete projects which require ability to solve complex engineering problems.

Initial Stage

Based on the on-site teaching of engineering scene which brings students into the engineering scene with presence, a triple student-centered educational field should be constructed so as to use its superimposed effect to enable students to enter the real work situation and complete engineering education with presence. As for the physical environment, with the software and hardware working environment currently used in the industry we build a real engineering application scenario. In terms of psychological construct, we guide students to enter the role of project work, cultivate the industrial qualities necessary for job roles, and support the on-site teaching of professional engineering education through industrial quality course. In professional engineering education, the professional core curriculum suitable for the current mainstream technology of the industry is driven by project work in real engineering scenarios while what students should do is not only deal with project tasks, but also understand the typical business background of the project in the industry and play a responsible role in their project work.
Lifting Stage

In order to guarantee the quality of talent training, we continue to improve the talent training system from two dimensions. The first is to improve the achievement of the training objectives as well as the compliance of training objectives with the industrial development needs. The second is the achievement of basic skill requirements and the conformity of occupational requirements with training objectives. In accordance with the evaluation-analysis-improvement circulating mode, we form closed cycles respectively for training objectives, graduation requirements and teaching activities to realize a perfect continuous improvement mechanism.

Reinforcement Stage

In the context of ICT industry development and upgrading, IT knowledge and CT knowledge are integrated and mutually infiltrated. Enterprise’s skill requirements for posts are no longer a single IT or CT skill, but ICT integration skill. According to the general ability standard of ICT talent training, on the one hand, aiming at the requirements of curriculum training, establish a new curriculum system, consolidate the foundation of mathematics physics and chemistry, and strengthen the construction of engineering foundation, ancillary facility and teaching materials. On the other hand, focus on the intersection and integration of different subjects, and establish a relevant curriculum group including courses of communication, computer, cloud computing, Internet of Things, network security, in order to develop students’ interdisciplinary skills inside and outside the posts.

All-round Development Stage

Improve capabilities of application and R&D in response to market demand. Relying on enterprise engineering projects, offer normative, professional and efficient services in aspects like demand analysis, project planning, product development and R&D support. Cooperate with the teachers in school to carry out scientific research and innovation and to cultivate students' scientific research thinking and ability, in order to enhance the overall ability of cooperative schools to participate in industrial research. Focus on cultivating the ability to use professional theoretical knowledge to solve problems, and introduce enterprise horizontal issues and social service projects that respond to market demand to school. Enterprises provide standardized, professional and efficient services from aspects like demand analysis, project planning, project implementation, and cooperate with teachers in schools to carry out curriculum innovation practice and application, and implement industry promotion and commercial application of major achievements.

Table 1. Ability Requirements at Each Stage.

| Graduate Ability Requirements | Initial Stage | Lifting Stage | Reinforcement Stage | All-round Development Stage |
|-------------------------------|---------------|---------------|---------------------|-----------------------------|
| Basic Engineering Knowledge   | ✓             | ✓             | ✓                   | ✓                           |
| Basic Analytical Ability      |               | ✓             | ✓                   |                             |
| Solution Design Ability       |               |               | ✓                   | ✓                           |
| Research Effort               | ✓             | ✓             | ✓                   |                             |
| Tool Ability                  | ✓             | ✓             | ✓                   | ✓                           |
| Engineering Ability           |               |               | ✓                   |                             |
| Environmental Protection Ability |           |               | ✓                   |                             |
| Vocational Normative Ability  | ✓             | ✓             | ✓                   | ✓                           |
| Team Building Ability         | ✓             | ✓             | ✓                   |                             |
| Communication Ability         | ✓             | ✓             | ✓                   |                             |
| Project Management Ability    |               | ✓             | ✓                   |                             |
| Continuous Improvement Effort  |               |               | ✓                   |                             |
Summary

The reform of education and teaching mode, based on the widely used commercial hardware equipment and industry-leading information-based teaching platform, provides a practical training environment integrating industry experience, job skill practice and engineering project exercise for universities. Guided by industrial market demand, with curriculum system focused on ability cultivation, high-quality and efficient teaching of specialized course combined with project teaching method is achieved so as to help colleges and universities promote the reform of teaching and training mode and finally realize the cultivation of practical technical talents. Under the framework of school-enterprise cooperation, students oriented is the priority of curriculum co-construction, that is to say, students are regarded as the primary target of service. Satisfaction of students and enterprises with services provided by school or curriculum is an important indicator of whether or not they can pass the certification. Student-centered and outcome-based requirements are secondly demanded by curriculum co-construction. The effectiveness of curriculum education is evaluated in line with graduates’ core competence and professional quality. Evaluation of conformity and continuous quality improvement are thirdly emphasized and a continuous effective quality improvement mechanism is required to establish. Through the school-enterprise cooperation, enterprises can help colleges and universities create application-oriented curricula and promote the deep curriculum transformation of colleges and universities in talent training, professional teaching, quality education and human resource service with the close connection between professional education and regional industry development, in order to achieve the ultimate goal of industry-teaching integration.

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