A New Model of Service-oriented Engineering Training with Industry Characteristics

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ABSTRACT

Engineering awareness training corresponding to the industry development trend is an important means to cultivate advanced applied technical personnel needed by the industry. In view of the current industry servitization, a new idea of reforming service-oriented engineering training model in higher engineering education is put forward with connotation elaboration and its implementation plan and a series of supporting measures are discussed, thus providing a reference for the reform of engineering training course in colleges and universities with engineering industry characteristics.

Introduction

With the deepening of higher education reform, colleges and universities have become increasingly clearer about their own development orientation, getting rid of the merging development model for the purpose of "big and complete" comprehensive university. Colleges and universities of different levels and different types have different personnel training objectives and different social service functions. Thus, positioning and development mode of colleges and universities vary[1]. In China, a considerable number of colleges and universities have strong industry characteristics, which are also known as industrial colleges and universities. The personnel training goal of industry colleges and universities is to cultivate applied advanced engineering and technical personnel needed in the industry. Engineering training in such colleges and universities should embody industry features by constructing basic training and innovation training system corresponding to industry characteristics. More importantly, teaching staff should update the teaching concept, improve teaching methods, pay close attention to industry development trend, integrate industry development orientation with teaching to achieve a smooth convergence between school teaching and future employment[2].

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At present, study on the reform of engineering training is mainly focused on the two aspects: construction of teaching system[3-4] and update of teaching contents[5]. Although many scholars have suggested that engineering training should pay attention to cultivation of engineering awareness, most is in the form of engineering history lectures or integrated school practice & innovation, rare attention is given to the impact of industry development trend on engineering awareness cultivation, somewhat of work behind closed doors. The manufacturing industry shows an increasingly obvious development trend from "product" to "service". In engineering training teaching, industrial colleges and universities should conform to this trend, reflect the industry development trend in the teaching process, update the teaching mode and teaching idea by leveraging the industry development trend, so that students are inspired by industry development in the daily teaching, with engineering awareness and capacity enhanced.

The connotation of service-oriented engineering training model

Since the late 20th century, products in major industrial countries such as Europe and the United States contribute increasingly less to enterprise profits, while services increasingly contribute more. This "product"-to-"service" development trend is increasingly obvious since entry into the 21st century[6]. Engineering training as an important means to cultivate students' comprehensive quality, engineering awareness, innovation ability and understand enterprise operation & management and quality management, shoulders the responsibility of cultivating students into applied advanced engineering technical personnel. In engineering training teaching, industrial colleges and universities should keep abreast of the trend of industrial transformation and permeate the development trend into daily teaching activities, unconsciously cultivating students' engineering awareness so that teaching and practice are closely linked.

In this industry background, service-oriented engineering training model came into being. The so-called service-oriented engineering training model means decreasing the proportion of "knowledge-based" teaching and increasing the proportion of "service-oriented" teaching in the course of engineering training teaching, to gradually promote the integration of knowledge and service, cultivate students' independent personality and innovation ability, and enhance the quality of engineering training teaching. "Knowledge" here refers to a variety of declarative knowledge and procedural knowledge, that is, the various theoretical knowledge acquired by students during college study; "Services" refers to a variety of methods, means to acquire knowledge, as well as a variety of learning resources. In service-oriented engineering training model, student participation in the teaching process design is emphasized, while in the previous teaching, students only participate in classroom teaching activities. There are the following reasons why students should participate in the full teaching process:

1) It helps improve the pertinence of service-oriented teaching

An important feature of service-oriented engineering training is that students participate in teaching content design and teaching reflection process, so that student, as a factor easily overlooked in the previous teaching design, has significantly improved coverage by the "teaching spectrum". In this way, the teaching and learning relationship in the teaching process is effectively improved, changing “required to learn” to "I want to learn." Therefore, to meet the learning needs of different students, teachers must strengthen the pertinence of teaching and service provision, thus improving quality of curriculum teaching.
2) It helps shape students’ personality

Cultivating innovative engineering technical talents with innovative spirit and creative thinking has become the consensus of the domestic colleges and universities in engineering professional training. Innovation is inseparable from practice accumulation and independent personality. Service engineering training teaching model’s focus on student participation is to respect the students' needs for personality development, and actively create a variety of favorable conditions for students’ personality development.

3) It helps teachers to improve teaching deficiencies

Students' opinions and evaluations on the instructors and the course after the completion of the course study are the driving force for teachers to carry out teaching reflection and improvement. Teachers often reflect the teaching from the perspective of "teaching", which easily causes subjectivity in reflection and contributes little to teaching quality improvement. Nevertheless, students' opinions and evaluations will help improve curriculum teaching from the perspective of "learning", which means higher guiding significance for the future teaching quality improvement.

Implementation of service-oriented training model

Service-oriented engineering training teaching model is a complete teaching system whose implementation needs support of multiple-aspect coordinated development in teaching concept transformation, teaching content design, teaching platform and teaching management.

Teaching concept transformation

The service-oriented engineering training model, composed of two basic elements of service-oriented teaching and teaching service, emphasizes full-course participation of students. Wherein, service-oriented teaching means teaching activities of engineering training should serve student personality development and innovative and practical ability improvement. Teaching service means the various tangible or intangible teaching resources for students to discover, tap, reprocess and transfer knowledge. It can be seen here that service-oriented engineering training model emphasizes that students take the initiative to conduct exploratory practice, while teachers take the initiative to guide the heuristic teaching. This requires instructors to transform teaching concept, reduce the proportion of direct knowledge infusion in classroom teaching, but actively provide students with teaching services to solve a variety of practical problems instead, so that students can solve the problems based on their own knowledge structure after receiving these services, and finally update their knowledge structure and improve innovative practical ability by solving the problems.

Update in the teaching content design

As the service-oriented engineering training model lets students to carry out exploratory practice after receiving teaching services, teachers’ choice of teaching content should focus on service-oriented teaching resources. The service here can include theoretical knowledge, action skills, practical experience in traditional sense of knowledge, or it can be hardware and software resources supporting practice progress, such as instrumentation, measurement tools, simulation software. Teaching services feature diverse types and complex sources. If these services are directly instructed to
students as teaching content, students will inevitably feel at a loss in knowledge acceptance. Therefore, teachers should classify and re-process these service resources in teaching content design, and modularly pack resources with similar functions to facilitate teaching service module combination and matching in teaching.

**Construction of the teaching platform**

Whether the service-oriented engineering training model can be carried out smoothly and to what degree it can be carried out, in a large part, depends on whether there is a modern teaching platform adapted to its characteristics. First of all, to make students participate in the full teaching process, the teaching platform should break the time and space constraints, so that students can provide feedback on learning effects and comments through the platform at any time; second, the teaching platform demands a certain degree of intelligence. Due to complexity of service resources, students may lack ability to screen complex service resources in independent learning using the platform. Intelligent teaching platform has certain ability to classify, match and combine service resources, and can select the service resources with strong correlation according to the students’ learning interests and requirements for their reference. Another feature of the intelligent platform is its ability in proactive discovery of new technologies and development trends in the industry so that these new service resources can be integrated into existing service resources on the platform in a timely manner. The third feature of the intelligent platform is its ability in self-update. The new service resources discovered by the platform through the network and hardware storage resources of the platform constitute a pair of irreconcilable contradictions. Under the constraints of platform operation and maintenance costs, this contradiction can only be mitigated by eliminating obsolete service resources or those unsuitable for training in the school environment. Again, teaching platform needs establishment of complete service resource library. Service resources include tangible hardware service resources and intangible software service resources, so the construction of service resource library should focus on characteristics of these two categories of service resources. For tangible hardware service resources, the basic information should include name, storage address, operating instructions, taboo in use, etc. For intangible software service resources, the basic information should include installation instructions, usage instructions, preparation instructions, etc. Finally, teaching platform demands openness. Openness of service-oriented teaching platform is first demonstrated in its network interconnection, as students inside and outside the school can access the platform at any time without time and space constraints. Platform openness is also reflected in openness of service resources, as access, query, download and use of the service resources provided by the platform are available through the network.

**Update in teaching management model**

Service-oriented engineering training teaching model must have a corresponding teaching management model to render smooth teaching process. As the constraints in time and space are broken, students’ learning time is not limited by fixed class and classroom, and construction of flexible training model can solve this problem. Via flexible training model, students can complete the agreed training tasks at the pre-agreed time and place. Another advantage of flexible model is that it can match the modular service resources, so that students can freely select corresponding service resource module from the service resources for combination training according to their
hobbies or design tasks. Secondly, a modular credit system management model should be established. Modularity is a sense relative to service resource modularity. Because modularization of service resources facilitates resource reorganization and helps students carry out innovative practical activities, the teaching process should be divided into modular courses corresponding to modular resources one by one, which helps teachers provide more targeted training services for students’ training. Meanwhile, module is linked to credits, as students can gain corresponding credits after completion of a module. A certain number of innovative credits can be added for students without learning difficulties, so that students can gradually gain corresponding credits in the training process which effectively avoids the written examination drawbacks in testing effect of the practice.

CONCLUSION

To cultivate advanced applied technical personnel adapted to the new situation, industrial engineering colleges and universities must pay attention to the undergoing structural changes in the industry. The current industry is witnessing a growing trend of transformation from provision of product to service. The teaching model of engineering training courses should take the initiative to adapt to this change, shifting from knowledge instruction to students to provision of knowledge acquisition service. This paper puts forward the concept of service-oriented engineering training model, and elaborates its implementation process, in an effort to permeate engineering awareness in daily school teaching & training process, so that students can recognize industrial development direction and receive high quality engineering education.

ACKNOWLEDGMENT

The first author wishes to acknowledge the financial support of the financial support of Hubei provincial teaching and research project in higher institutions (No. 2015239, No. 2015226); Wuhan University of Science and Technology teaching and research project (No. 2015Z002, No. 2017X062). Thanks for all the authors of the references who gives us inspirations and helps. The authors are grateful to the editors and anonymous reviewers for their valuables comments that improved the quality of this paper.

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