Construction and Practice of Service-oriented Engineering Training System Based on SPOC Concept

Cao Jianhua[1,2], Xia Xuhui[1,2,*]

[1] Engineering Training Center, Wuhan University
of Science and Technology
[2] Key Laboratory of Metallurgical Equipment and
Control Technology (Wuhan University of Science and
Technology), Ministry of Education
Wuhan 430081, China

Wang Lei, Liu Xiang
Key Laboratory of Metallurgical Equipment and
Control Technology (Wuhan University of Science and
Technology), Ministry of Education
Wuhan 430081, China

Abstract—**This paper, closely focusing on the reform of national service-oriented education and the improvement of the comprehensive ability of college students and combining with the engineering training practice teaching link, explores and studies the individualized training mode and implementation approach of engineering training, and propose to establish a service-oriented engineering teaching platform based on SPOC concept. Besides, this paper also optimizes the engineering training practice teaching and training program, implements the "three-level, three-capacity, multi-module" practical teaching system, explores the new mode of "innovation ability improvement", and finally realizes the further students' comprehensive ability of practical and innovation.**

Keywords—SPOC; Service-oriented engineering training; Experimental platform; Comprehensive ability improvement

I. INTRODUCTION

Engineering training is an important part of practical teaching. It plays an irreplaceable role in improving the overall quality of students and cultivating high-quality, high-level engineering talents in the new century [1]. In recent years, the state has successively put forward the "Excellent Engineer Education and Training Program", the National Innovation-Driven Development Strategy Outline, and the "National Medium- and Long-Term Talent Development Plan (2010-2020)" and other important regulations, such as students' engineering practice ability and engineering design ability. Higher requirements are placed on engineering innovation capabilities [2-3]. In order to cultivate new types of engineering talents that meet the needs of social development, universities actively explore new ideas, new approaches and new methods for engineering training and teaching reform. Li Xiaochun proposed measures and suggestions for engineering training reform from the aspects of changing concepts, constructing ladder engineering training system, reforming teaching methods, etc. [4]; Han Xiaoxu proposed a new hierarchical competition-based teaching model based on the construction of service-based public training platform to meet the urgent need for the country to innovate entrepreneurship

and ability training for college students. [5]; Yang Haifeng et al. analyzed the current situation and causes of the construction and management of service-oriented engineering teaching laboratories [6]. Research by many scholars shows that service-oriented engineering practice teaching is an effective teaching mode. At the same time, the Outline of the National Medium- and Long-Term Education Reform and Development Plan (2010-2020) states that schools of all types and at all levels should "explore the establishment of management systems and supporting policies that conform to the characteristics of the school, and gradually eliminate the actual administrative level and administrative-ization management mode". At the same time, it is also proposed that vocational education should "service as the purpose, employment-oriented, and promote education and teaching reform", which points the direction for the reform of education management mode in higher vocational colleges, that is, the administrative management mode transform into a service-oriented management approach, build a "service-oriented" teaching management system that is people-oriented and suitable for higher education to train high-quality talents. In this context, the research team proposed a service engineering training system.

SPOC [7] (Small Private Online Course) is a curriculum paradigm of the post-MOOC era. It combines the teaching philosophy of MOOC and overcomes the shortcomings of MOOC in large-scale, pure online and ultra-multi-user online learning, such as high cost of course production, single teaching mode, lack of teacher-student interaction, high dropout rate and inconvenient learning and management [8]. It has service characteristics such as sharing, immediacy, interactivity, on-demand acquisition, and personalization [9]. Due to its many advantages, it has been widely studied by many scholars. For example, Lu Hong combined with the characteristics of the mixed teaching mode and has designed a SPOC platform for mixed teaching based on the problems of the existing SPOC platform in the process of mixed teaching application [10]; Lv Tingting used comparative experiments, quantitative analysis, questionnaire survey and other methods to study the college English flip classroom teaching mode

based on SPOC+ digital teaching resource platform [11]; On the basis of comparing MOOC and SPOC, Yin Hedong expounded several typical SPOC application cases at home and abroad, and explored the use of teaching-related theories to design a hybrid teaching model based on the Panya SPOC platform [12]. It is known from the research results of many scholars that the SPOC teaching platform based on the SPOC concept is of great significance to improve students' learning efficiency, comprehensive quality and innovative ability.

Therefore, based on the construction of SPOC teaching platform, the service engineering training system is constructed, and the existing training resources of the engineering training center and mechanical manufacturing, information technology and other related majors are integrated [13-14]. Carry out service engineering training system reform and practice research, improve engineering training teaching service module and knowledge service platform, and provide mobile tools for students' practice preview knowledge exchange. At the same time, optimize the engineering training teaching service team structure to provide guarantee for the effective operation of the service engineering training system based on SPOC platform.

II. SERVICE ENGINEERING TRAINING SYSTEM

Service-oriented engineering training is a new practice teaching form that integrates engineering training and service. It is a new teaching mode and engineering training organization. The project team combined the existing CDIO education model and service ideas in the engineering training center, and initially understood the service engineering training as: Service-oriented engineering training is to provide value-added value to stakeholders in the student's knowledge value chain. Through the integration of training product production and service, students' full participation, and teaching service providers provide theoretical/process/technical and other knowledge services and operational services. To realize the integration of service resources such as training equipment and teaching service providers, to achieve efficient innovation of engineering training service system, and to realize engineering training value and student value. On the basis of the preliminary understanding of service engineering training, the project team will deeply analyze the characteristics of engineering training and service, and study the concept and general connotation of service engineering training.

Service-oriented engineering training is based on engineering training services and service-oriented engineering training. It forms a polymer of value-added knowledge through the integration of product production, service provision and knowledge in the practice module. It is not only a new teaching mode, but also a new way of engineering training organization. Including the overall objectives of service engineering training, the conceptual structure of service engineering training, service content and optimization methods, service resources and their internal relations, service process design, service organization, service quality assessment methods.

In the context of the credit system teaching, according to different majors, optimize the engineering training practice teaching personnel training program, set practical innovation credits, incorporate the students' total credits, and implement the "three-level, three-capacity, multi-module" teaching system in a targeted manner. The three levels are engineering cognition and basic training, subject basic skills training and multidisciplinary knowledge integration practice, comprehensive innovation practice training, three abilities: basic practical ability, professional practice ability, practical innovation ability, multi-module, engineering training, various types of work Divided into 1-2 independent and interconnected modules. Students complete the operation training of the corresponding modules according to the minimum requirements of their majors. Just like the game clearance, all the module selection and scheduling are determined by the students themselves when resources permit. What to learn and when to study is determined by the students themselves, which greatly stimulates the students' self-learning enthusiasm, and students who are particularly interested in engineering training can also choose to practice the innovation module to obtain innovative credits after completing the training practice. And participate in various competition activities, so that they can learn from their strengths, and truly realize the teaching of students in accordance with their aptitude, which greatly enhances students' practical ability and comprehensive innovation ability.

Improve the engineering training intra-school competition, off-campus competition system, carry out comprehensive and multi-project engineering training competition activities, and form a long-term mechanism. Encourage engineering students to freely choose to participate in various competitions. In the practice training and competition innovation, "training with the competition and training for competition" will enhance their own capabilities and form a new model of "combination of competition and training". At the same time, non-technical students are encouraged to participate in product modeling and 3D printing service engineering training platform construction.

III. SERVICE-ORIENTED ENGINEERING TRAINING PLATFORM BASED ON SPOC

Based on the original CDIO training platform, combined with the characteristics of SPOC concept and service engineering training, a service engineering training platform based on SPOC has been established. It improves the hardware facilities of knowledge service platform, and optimizes the knowledge service software platform. It mainly includes front-end analysis, course design, process organization, teaching evaluation, and training platform knowledge base and hardware library support.

(1)Front-end analysis is mainly the analysis of the three elements of training objects, training content and training environment. Among them, the training object mainly analyzes the student's age, major and grade information; The analysis of practical training content includes analysis of teaching objectives, syllabus, and teaching difficulties; The training environment is an important factor in determining service-oriented teaching, including the classroom teaching environment, the SPOC platform, practical operations, and of course other auxiliary media tools. Front-end analysis is the premise of curriculum design. Only by fully grasping the key points of front-end analysis can we design personalized and targeted teaching resources.

(2)Course design mainly refers to SPOC micro video recording, and also needs to prepare teaching plans, syllabus, PPT courseware, related literature and test questions. These resources are uploaded to the SPOC platform for online editing and integration, and then designed into a micro-course with logical structure. E-books, virtual simulation experiments, and movie recordings can be attached as extended resources. Teaching resources are the most important part of mixed teaching, and its design determines whether the subsequent personalized teaching services can be carried out smoothly. Therefore, the design of teaching resources should not only be rich in content, orderly, but also highly relevant to the knowledge of teaching. Otherwise, redundant and ineffective teaching resources will not only promote learning, but will interfere with students' understanding of teaching and difficult, which would bring a burden to their learning.

(3)Process organization includes diagnostic evaluation, personalized classification, and flipping classrooms. Diagnostic evaluation is mainly to test the students' original knowledge base and learning style, so that students can select group tutors according to heterogeneous grouping, layered teaching them, and push personalized tasks in groups. Learning from the flipping classroom mode, before the class, the students can understand the content guide, micro video, and complete the initial test on the SPOC platform. During the class, students will discuss the common problems, answer the difficult questions, comment on the homework, and let the mastered students can explain and display results and innovative application activities; After class, organize students to conduct offline communication and discussion, share the epiphany of learning in the class, and conduct topic discussion and PBL (problem-oriented learning) project practice through the SPOC platform.

(4)Formative evaluation and summary evaluation. The formative evaluation is based on the statistical video and video comparison of the SPOC platform, and discusses the big data information such as participation rate and job quality, and combines the feedback of the group tutor, the completion of the group project, the student's classroom performance, the student self-evaluation and mutual evaluation. Summative evaluation is mainly conducted in the form of semester examinations and results reporting. Teachers can adjust the teaching progress and improve the teaching methods in a timely manner through formative evaluation. They can also manage the students' learning behaviors. Once they find that students are learning abnormally, they will send reminders. Finally, the teacher gives the students quantitative points according to the weight ratio of formative evaluation and summative evaluation.

(5)The training platform knowledge base and hardware library are the foundation of the entire teaching service platform. The basic knowledge involved in the process modules such as front-end analysis, course design, process organization, and teaching evaluation, SPOC video, teaching courseware, test questions, software and other soft resources are stored in the service platform in the form of a knowledge base, which provide service support of taught and learning online for teachers and students. The hardware library mainly includes practical operation machining centers, CNC lathes, grinding machines, 3D printers, etc. These devices are connected to the teaching platform through virtualization technology, so that students can better understand these devices in the online learning process and operate through practice. The verification and consolidation of the knowledge learned will enable the integration of online and offline, theory and practice. The hardware library mainly includes practical operation machining centers, CNC lathes, grinding machines, 3D printers, etc., and these devices are connected to the teaching platform through virtualization technology, so that students can better understand these devices in the online learning process. Through the practice and operation, the knowledge is verified and consolidated, so that the integration of online and offline, theory and practice can be realized.

IV. CONCLUSION

Through the research and practice of service-oriented engineering training mode based on SPOC concept, it will play the following role in promoting teaching work and improving teaching quality:

(1) The construction and implementation of the service engineering training system has met the comprehensive ability improvement of "three-level, three-capacity, multi-module" training mode. For different majors, the engineering training practice teaching is divided into "three levels", namely engineering cognition and subject basic training, multidisciplinary knowledge integration training, comprehensive innovation training; "three capabilities", that is, basic practical ability, professional practice Ability, as well as innovative practice capabilities; According to the division of "three levels and three capabilities", the engineering training types are divided into several relatively independent and progressive operation modules, namely "multi-modules", to meet the needs of personalized on-demand service training. Students freely choose the training module and time, which stimulates students' enthusiasm for learning and cultivates students' comprehensive practical ability.

(2) By constructing the SPOC training teaching service platform, it provides information support for the efficient implementation of the service engineering training mode. The SPOC training platform is student-centered, and realizes a variety of interactions between students and training platforms, training teachers' online and mobile interconnections, and combines "online learning training" with "on-the-spot operation", which breaks the time and space constraints in engineering training and teaching, The students brought the problems found in the pre-study and virtual practice to the scene. The teachers conducted targeted practical guidance, realized the role flipping of students and teachers, stimulated the autonomy and initiative of the students, and improved the effect of engineering training.

(3) The service engineering training service module based on SPOC teaching platform is determined by the combination of students' professional characteristics and hobbies. The service implementation is based on service teachers and constructs a service-oriented engineering training mode, which can effectively promote the structural adjustment of the teaching service team. It improves the ability of service teachers and builds a service-oriented engineering training

model, which are important measures for building a service-oriented high-level teaching team and an important link for establishing a new teacher-student relationship.

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