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Construction and Practice of "Java Web Programming" Golden Course Based on CDIO-OBE Concept*

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Abstract—By integrating CDIO engineering education concept into the entire teaching process of "Java Web Programming" course, this paper explores the construction of a golden course with challenging content in combination with theory and practice, taking students as the center, result as the direction, project as the carrier and the "two natures and one degree" of golden course as the criteria. The course is driven by learning results, implements project-based teaching based on work process, and adopts online and offline blended teaching model and multiple evaluation methods. The construction of golden course can not only improve students' engineering practice ability, learning ability, organizational coordination and communication ability, but also provide more referential experience for the construction of other golden courses in major of computer science.

Keywords: CDIO-OBE, golden course, online and offline blended teaching model, multiple evaluation methods

I. INTRODUCTION

In June 2018, Chen Baosheng, the Minister of Education, proposed at the National Conference on Undergraduate Education in Higher Education Institutions in the New Era that the "common course" should be truly transformed into a "golden course" with depth, difficulty and challenge [1]. The golden class can realize the organic combination of knowledge, ability and quality, and train students' comprehensive ability and advanced thinking to solve complicated problems. The course content reflects the epochal character and pioneering nature. The teaching style is advanced and interactive, and the learning effect is exploratory and personalized. The Java Web Programming

Course is a highly practical and engineering course for computer major. This course is based on the CDIO education model. It is student-centered, results-oriented, and project-based. It aims to fully explore and practice the construction of Java Web golden course, taking students as the center, result as the direction, project as the carrier and adopting discussion-based experience learning, open classroom communicative teaching and multiple evaluation methods.

II. DESIGN IDEAS FOR CONSTRUCTION OF "GOLDEN COURSE" BASED ON CDIO-OBE

In order to improve the teaching quality and cultivate applied innovative talents, the Java Web related teaching contents are collected and sequenced and scientifically designed based on the actual teaching task and process in accordance with the "two natures and one degree" criteria for evaluation of golden course taking the "CDIO-OBE" engineering education model as the supporting point and improving students' computer software design and development ability as the main line, in order to realize the integration of teaching, learning and practice. The entire teaching is conceived, designed, developed and operated around actual projects. Teacher can take students as the center and result as the orientation and take many teaching methods such as project based teaching method, discussion based teaching method and flipped classroom teaching method to let students know what to learn and do and how to do it before completing the project. The purpose is to cultivate students' learning ability, innovative exploration ability, teamwork ability and independent thinking ability, improve their employment ability and meet the needs of enterprises. The design ideas of the course construction are shown in "Fig. 1":
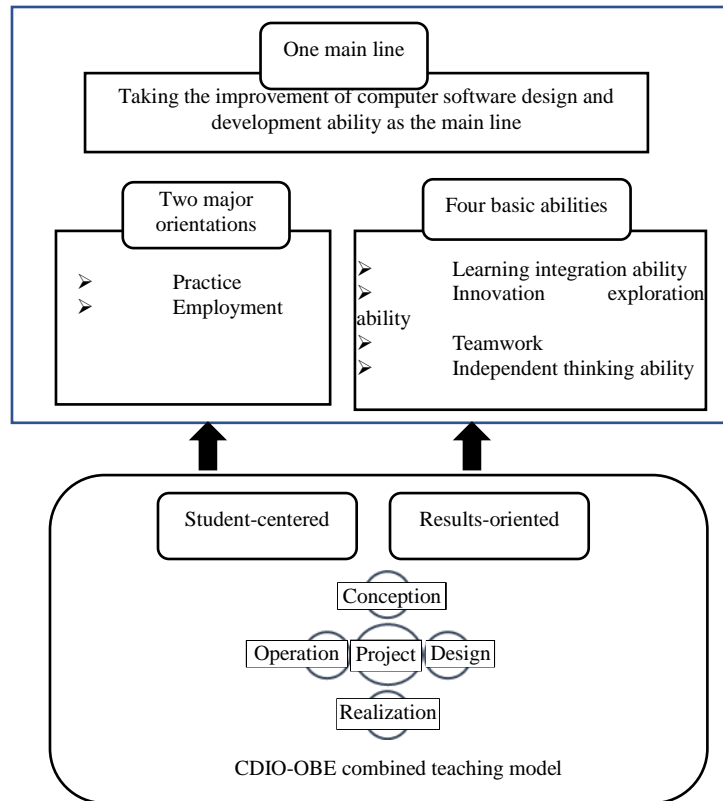
Fig. 1. Course construction ideas.

III. CONSTRUCTION AND REALIZATION OF "GOLDEN COURSE" BASED ON CDIO-OBE

Zaozhuang University adheres to the school-running principle of "being teacher-oriented in school running and being student-oriented in teaching". In the overall design of the school's majors and teaching links, attention is paid to the connection between talent training and social needs. The university advocates the reform of teaching model, breaks the traditional "teacher-teaching and student-learning" model, trains students from passive learning to active innovative research and development through the "project-driven" teaching model, and makes use of the current learning media such as the Internet and mobile Internet to improve students' learning ability and innovation consciousness [2].

The CDIO-OBE-based engineering education model enables students to learn engineering technology in a practical, active, and inter-curricular manner, and achieve the unity of skills, knowledge, methods, value learning, and emotional attitudes. Starting from the job requirements of Java Web software development engineers, school can put into practice the concept of "orienting to promote employment on the basis of improving job ability", optimize the talent cultivation plan as per the industrial needs, make an overall thinking of the industrial needs, reconstruct the teaching content in "project-driven mode" to mainly cultivate students' vocational ability, and design the teaching content matching with the job requirement. Then, school should orient to the teaching result, and make cultivation target, select teaching content and determine the evaluation method as per the final result.

A. The establishment of CDIO-OBE-based course training goals

This course uses the project-led online and offline blended teaching model, designs and formulates CDIO-OBE-based Java Web course training goals, clarifies the course's CDIO standards and cultivates students' CDIO ability. The CDIO-based Java Web course development goals include knowledge goal, ability goal, and quality goal.

In terms of knowledge goal, students should be able to use Eclipse integrated development tools, apply JSP related technologies, Servlet technology, session tracking technology, JavaBean technology, EL expressions and custom tags, filters, sound monitor, MVC development mode and other basic Java Web technologies to develop, deploy and run a software.

In terms of ability goal, students should have normative coding habits and good object-oriented programming thinking ability and can use UML modeling methods to analyze, design and develop a given Web software;

In terms of quality goal, students should have good ability to analyze and solve problems, have better information retrieval ability, have good professional ethics and teamwork spirit, have good ability to communicate and exchange with others and have realistic scientific attitude, rigorous work attitude and innovative consciousness.

B. *Project-led design of online and offline blended teaching model*

Java Web Programming adopts project-led online and offline blended teaching model as shown in "Fig. 2". In this model, teacher can release the course goal to students before class and students learn relevant micro-videos on the Chaoxing MOOC platform according to task in the project task list and the course goal to understand the basic knowledge and complete online test and project cases. In this process, teacher needs to pay attention to students' online learning at any time, answer questions online, record common difficulties in students' implementation of the project, summarize the problems existing in students' learning based on test results and difficulties encountered in the project development, and give a unified answer or organize a discussion in class collectively.

The main purpose teaching in class is to enable students to consolidate and improve the knowledge they have learned, and to continuously improve their project development capabilities. Classroom teaching is conducted in groups. According to the completion status of students' online learning and extra-curricular project cases, teacher proposes the contents to be discussed in class and organize the discussion in form of group discussion and group defense in class. This way can not only cultivate students' teamwork consciousness but also cultivate their ability to ask, analyze, and solve problems, and fully mobilize students' initiative and enthusiasm for learning. If students encounter common difficult problems, teacher needs to explain them collectively and avoid waste time in ineffective discussions [3]. After the discussion, students will have a deeper understanding of the key knowledge points by showing and explaining classic project cases designed by teacher. In classroom teaching process, teacher needs to observe students' discussions, learning, and classroom performance at any time, and form a classroom evaluation at the end of the lesson.

After class, students can make self-summary to check for leaks and fill gaps, and improve the knowledge structure. Each group can integrates what they have learned to continuously improve the enterprise project. In the process of continuous completion of the project, students' learning ability, coordination and communication ability, and project development ability can be improved by searching information, group discussions, and constantly improving their understanding and mastering of the knowledge. Adopting blended teaching model can help to fully mobilize students' learning enthusiasm, teach students how to learn, and cultivate students' lifelong learning habits.
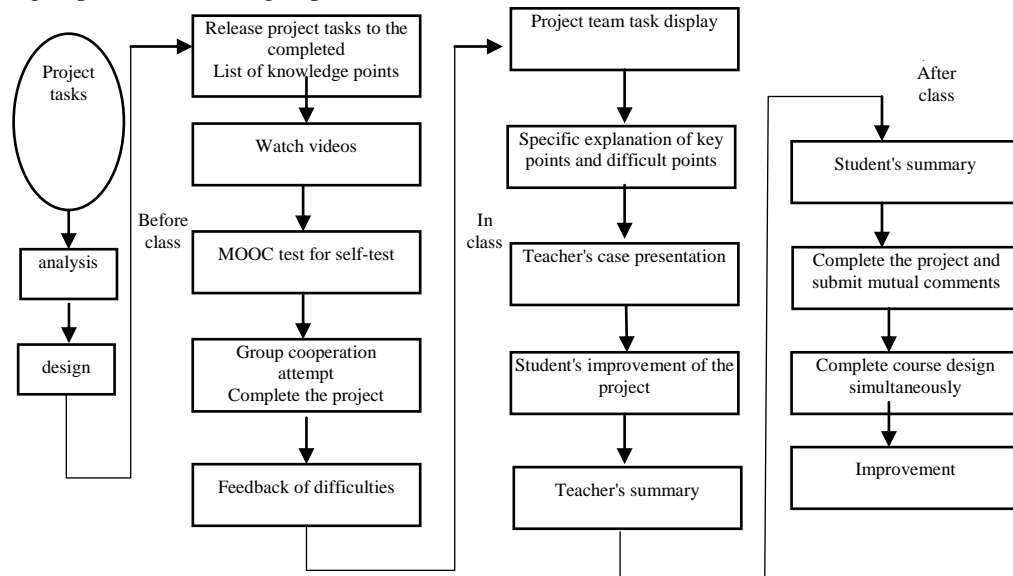

Fig. 2. Project-led online and offline blended teaching model.

C. *Teaching content design*

According to the CDIO engineering education model, the teaching of this course takes project as the carrier, decomposes relevant knowledge points into actual project, and integrates the teaching content. The project is divided into three levels: basic cases, expansion cases, and production innovation projects. The basic knowledge of this course is deconstructed into the Book City project. And the teaching contents are integrated based on actual work tasks and work processes. It is to realize a combination of teaching, learning, and practice. The purpose is to cultivate students' learning ability, creative exploration ability and practical ability. The traditional subject-based teaching system is transformed into a course system based on work process, as shown in "Fig. 3".
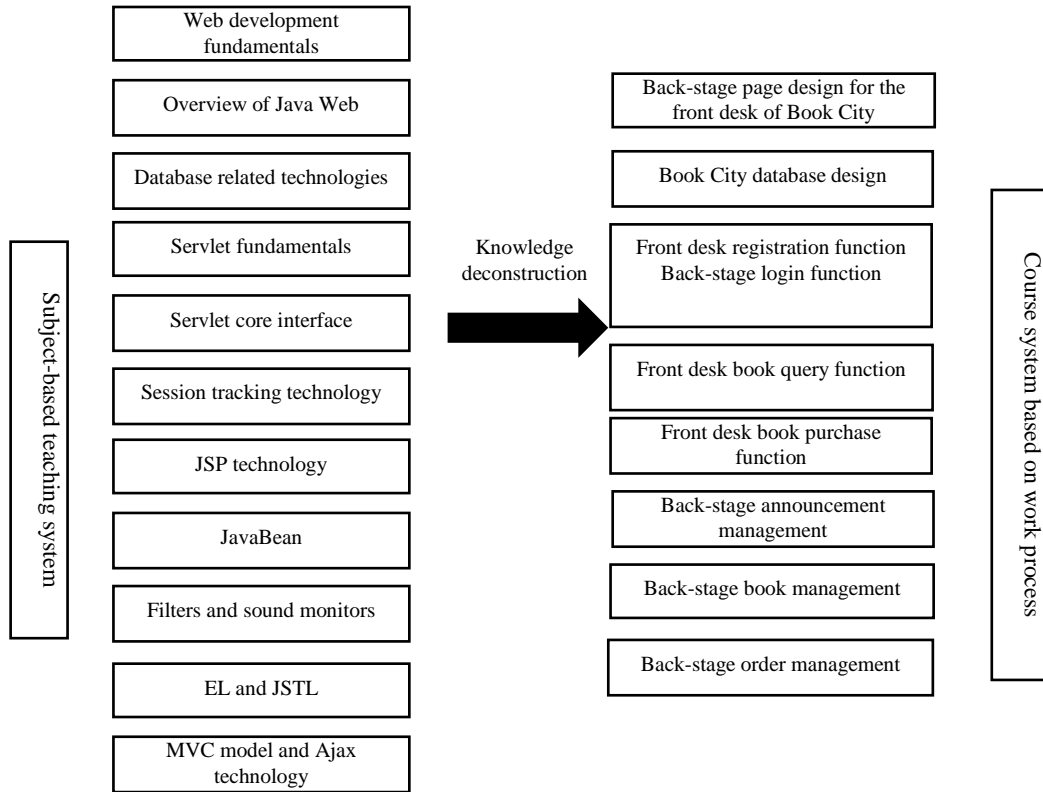
Fig. 3. Course system based on work process.

After class, students can simulate and complete the extended case of enterprise recruitment website based on the basic case learned; moreover, project team members can make investigations and select a subject to design and develop a software based on actual production. By practicing the basic cases, expanded cases, production project design and development, each group can be greatly improved in the ability to develop software.

D. Multiple evaluation methods

The course evaluates students from multiple aspects, focuses on evaluate students 'actual software design and development ability, teamwork ability, and innovative consciousness. The evaluation method is combined with training objectives, and mainly evaluates the achievement of students' learning under the corresponding training objectives [4].

The evaluation method of this course is divided into diagnostic evaluation, process evaluation and summary evaluation. Diagnostic evaluation uses the questionnaire to grasp students' knowledge and learning ability, and lay the foundation for subsequent teaching. Process evaluation is used to understand students' mastering of stage knowledge through experiments, classroom performance, and online testing [4]. The project defense is to understand the overall knowledge mastering status of students, and analyze problems in teaching to facilitate later teaching improvements.

E. Teaching effects

After nearly two years of exploration and practice, based on the CDIO-OBE concept, project-led online and offline blended teaching model can be used to carry out teaching reform on the Java Web Programming course. "Table I" shows the ratio of the number of students in each score range of the experimental class under this teaching model and the regular class in 2019. By comparison, it is found that the ratio of the number of students in low score range in experimental class is low. The number of winning teams in experimental class is higher than that of regular class.

TABLE I. COMPARISON OF TEACHING EFFECTS

Class	0-59	60-69	70-79	80-89	90-100	Software Contest Winning Team
Experimental class 1	1	3	11	22	63	5
Experimental class 2	0	6.2	16.8	39.6	37.4	4
Regular class 1	12.8	18.9	24.8	26.7	16.8	0
Regular class 2	7.7	9.2	24	33	26.1	1

IV. CONCLUSION

In recent two years, good teaching effect has been achieved by incorporating the CDIO engineering education concept into the Java Web programming teaching, and adopting the project-led online and offline blended teaching model to carry out teaching reform. From the system data, up to now, 24 experiments have been released, 1873 student assignments have been checked, 36 online tests have been carried out at the frequency of 2679 persons ·time. Because the experiments and tests submitted by students in each class can get in-time feedback, students are highly enthusiastic about learning. The completion rates of experiments and tests in the experimental class are all higher than that in the regular class. In class, the project is demonstrated by the project team. On the one hand, this way exercises students' language expression ability; on the other hand, the students' teamwork ability is improved. According to the classroom performance of students, the activity of mutual evaluation among students is added, which greatly mobilizes the students' enthusiasm for learning and improves the students' software development capabilities.

With the deepening of information-based education, more and more computer programming courses will adopt the project-led online and offline blended teaching model. It is believed that this teaching model will surely inject new vitality into programming language teaching, fully mobilize students' learning enthusiasm, create more high-quality courses, and truly improve the quality of talent training.

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