Research on the Construction of Computer Courses Based on CBE-CDIO Engineering Education Concept: Taking the Course "JAVA Programming" as an Example

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Abstract

As an important part of training engineering talents, computer courses are faced with the challenge of how to better adapt to the rapidly changing development of science and technology and meet the needs of industry. CBE-CDIO (Competency-Based Education Conceiving-Designing-Implementing-Operating) engineering education concept, with its characteristics of focusing on practice, team cooperation, and whole-person education, provides new ideas for curriculum construction. Taking the "JAVA Programming" course as an example, this paper discusses how to build computer courses based on the CBE-CDIO concept to cultivate students' engineering practical skills and comprehensive literacy.

Keywords

CBE-CDIO concept
Engineering education
Computer courses
JAVA programming

1. Introduction

Computer courses are of great significance in today's information age. Cultivating students' computer programming and problem-solving skills is one of the important tasks of education. However, traditional computer courses often face problems such as too many knowledge points and disconnection between theory and practice. In order to improve the quality of education and cultivate the practical skills of students, more and more educational institutions began to adopt the CBE-CDIO engineering education concept to construct the curriculum [1]. The CBE-CDIO concept focuses on the cultivation of students' abilities and the improvement of their practical skills, emphasizing the role of students in engineering practice and their ability to solve practical problems [2].

2. Overview of CBE-CDIO engineering education concept

CBE-CDIO engineering education concept, that is, competency-based engineering education and engineering education of conception, design, implementation, and operation, is an innovative educational concept aimed at cultivating students' comprehensive literacy and

practical skills in the field of engineering. The core of this concept is to emphasize students' skills training and focus on combining theoretical knowledge with practical application as well as to prepare students for future engineering practice [3].

The CBE-CDIO concept emphasizes practice orientation and focuses on students' performance in practical applications. Specifically, CBE takes students' skills as its core goal, breaks through the constraints of traditional curriculum settings, and pays more attention to students' ability to show what they have learned through practical projects and tasks. CDIO guides education throughout the entire process of engineering practice, from conceptual design to practical operation [4].

Under the framework of CBE-CDIO, engineering education pays more attention to students' ability to solve problems in practical situations, not only the teaching of subject knowledge but also the cultivation of students' innovative consciousness, teamwork, and practical operation skills [5].

3. The significance of "JAVA Programming" course construction under the concept of CBE-CDIO engineering education

3.1. Meeting the needs of the times

With the rapid development of information technology, computer programming has become an indispensable skill in modern society. Under the guidance of the CBE-CDIO engineering education concept, the construction of the "JAVA Programming" course aims to meet the needs of the development of the times. By learning the JAVA programming language, students can fully grasp the basic concepts and methods of programming, and deeply understand the process and norms of software development, so as to better adapt to the development needs of the information age. The development of modern society cannot be separated from the support of information technology, and computer programming, as the core of information technology, has penetrated all walks of life. Whether it is software development, data analytics, or artificial intelligence, specialized programming skills are needed. Therefore, taking JAVA programming courses allows students to master a programming language that is widely used in various industries, laying a solid foundation for their future career

development [6].

3.2. Cultivating students' innovative spirit and practical skills

Under the guidance of the CBE-CDIO engineering education concept, the significance of the construction of the "JAVA Programming" course lies in cultivating students' innovative spirit and practical skills, which is reflected in the course design. Teachers introduce project cases with practical application scenarios, which can stimulate students' interest in problem-solving and cultivate their practical skills to solve practical engineering problems [7]. At the same time, the CBE-CDIO concept encourages interdisciplinary collaboration, which also provides students with more opportunities to demonstrate their innovative spirit, thus strengthening their teamwork and innovation ability. In the course design, teachers set up project-driven tasks to guide students to start from reality and improve their practical skills to analyze and solve problems. This is not only a simple application of JAVA language knowledge, but also a systematic training of innovative thinking and practical problem-solving. Through participation in the project, students can not only learn grammar rules but also programming skills. They can deeply understand how to apply the knowledge to the actual project, practicing their actual hands-on skills [8].

3.3. Enhancing students' comprehensive skills and professional competitiveness

Based on the CBE-CDIO engineering education concept, the construction of the "JAVA Programming" course is of great significance for improving students' comprehensive skills and career competitiveness. Firstly, the course focuses on cultivating students' comprehensive qualities, including problem-solving skills, teamwork, and communication skills. In project-driven teaching, students develop their problem-solving skills by facing specific engineering problems and analyzing, designing, and implementing solutions [9]. At the same time, through teamwork, students can learn to work cooperatively with division of labor, and communicate effectively, which improves their teamwork and communication skills. These comprehensive skills are crucial for students' future career development and enable them to better adapt

to and cope with various challenges in practical work. Secondly, through the study of the "JAVA programming" course, students can obtain valuable vocational skills and enhance their competitiveness in the job market. At present, computer programming has become one of the indispensable skills in modern society, students who master the JAVA programming language will have the ability to develop all kinds of software and applications, and are expected to find employment opportunities in software development, data analysis, artificial intelligence, and other fields [10].

3.4. Promoting quality and innovation in education

Under the guidance of the CBE-CDIO engineering education concept, the construction of the "JAVA Programming" course is of great significance to promote the quality and innovation of education, which advocates students' active learning and practical inquiry and encourages them to actively participate in project-driven tasks. Through practical projects, students can better understand and apply the knowledge they have learned, exercise their ability to solve practical problems, and enhance their independent learning and innovative thinking [11]. At the same time, the CBE-CDIO engineering education concept emphasizes interdisciplinary cooperation and comprehensive practice, and organically combines "JAVA programming" with other engineering disciplines. Such interdisciplinary integration helps to expand students' vision and cultivate their comprehensive skills and innovative consciousness, and students can explore new problems and solutions through cross-learning with other disciplines. They can also develop the ability to think across disciplines, thus providing more possibilities for future engineering practice [12].

4. The path of "JAVA Programming" course construction under the concept of CBE-CDIO engineering education

4.1. Setting of course objectives

Under the CBE-CDIO engineering education concept, the goal of the "JAVA Programming" course is to comprehensively cultivate students' practical skills and innovative spirit. First of all, the course should clarify the core knowledge and skills that students should master,

such as the basic syntax of JAVA language, object-oriented programming ideas, and commonly used data structures and algorithms, which are the key elements to build students' programming foundation for their future engineering practice [13]. Secondly, the curriculum emphasizes the cultivation of students' practical skills. Through project-driven learning, teachers enable students to apply what they have learned to solve practical problems. Project-driven teaching focuses not only on implanting theoretical knowledge but also on cultivating students' practical hands-on skills in engineering practice through the design and implementation of practical projects. This is not only the application of JAVA language knowledge, but also the systematic training of students' practical problem-solving skills. Lastly, the curriculum encourages students' innovative thinking, which is an indispensable quality in the engineering field [14]. Therefore, teachers should actively carry out innovative projects and practical activities, so as to stimulate students' creativity and problem-solving skills. Moreover, teachers should cultivate students' independent thinking and innovative ability in the field of JAVA programming in the curriculum objectives. This can enable them to tackle the challenges of complex engineering projects and emerging technologies in the future [15].

4.2. Design of teaching content

Under the guidance of the CBE-CDIO engineering education concept, the teaching content of the "JAVA Programming" course should be closely integrated with the actual needs and industry development trends. Teachers should introduce practical cases and application scenarios to let students understand the application of JAVA language in practical development, so as to better promote students' understanding of the application of theoretical knowledge in practical projects and improve their practical skills to solve problems [16]. Teachers should also set comprehensive project tasks and require students to perform a complete software development process with what they have learned, from requirement analysis and system design to coding implementation and testing. This process will comprehensively train students' comprehensive literacy and cultivate their practical experience in actual engineering projects, which is also advocated by the CBE-CDIO concept.

Teachers should pay attention to the overall quality training of students, instead of only focusing on imparting theoretical knowledge, they also need to pay attention to the process of solving practical problems. Lastly, teachers should introduce cutting-edge technologies and research directions, so that students can understand the latest developments of JAVA language and cultivate their innovation awareness and research ability, which is also in line with the requirements of the CBE-CDIO engineering education concept. Even after the completion of the course, students can still maintain sensitivity to the latest developments in the field [17].

4.3. Selection of teaching methods

Under the CBE-CDIO engineering education concept, the teaching method of the "JAVA Programming" course should emphasize students' active participation and practical operation. In order to achieve this goal, teachers can adopt a variety of teaching methods and combine them organically. First of all, teachers can use a combination of teaching and demonstration to explain basic concepts and demonstration code and guide students to understand and master the basic knowledge and skills of the JAVA language. Teaching can help students understand abstract concepts through clear and concise language, combined with vivid examples and diagrams, and by demonstrating the actual coding process, teachers can show correct programming ideas and skills, and stimulate students' learning interest and motivation. Secondly, teachers can divide students into groups, and each group is responsible for completing a project task, so as to encourage students to solve problems together and cultivate teamwork and communication skills [18]. In group cooperative learning, teachers can play the role of mentors, provide timely feedback and guidance to students, and help them overcome difficulties and improve their problem-solving skills. In addition, teachers can provide relevant literature and resources to guide students' independent learning and in-depth research and encourage students to participate in open-source projects or other practical application development, so that they can broaden their knowledge and accumulate experience through practical exploration and operation. In this process, teachers can act as mentors for students and provide them with necessary support and guidance [19].

4.4. Establishment of evaluation system

In order to comprehensively assess students' knowledge mastery and skills level, teachers can adopt the following diversified evaluation methods. On the one hand, teachers can set up tests to examine students' mastery of JAVA language and application skills. The tests can include multiple-choice questions, fill-in-the-blank questions, programming questions, and other forms, covering all important knowledge points and skill requirements of the course. On the other hand, teachers can assign homework that requires students to complete programming tasks or solve practical problems independently, and the homework can cover different aspects of the course content, examining students' theoretical knowledge and focusing on their practical skills. In addition, teachers can also require students to submit project reports and practical results. Students are allowed to choose a specific project and develop it, complete the design, implementation, and testing of the project, and write the project report. Teachers can also adopt the method of student self-evaluation and mutual evaluation, so that students can evaluate their own learning performance and that of their peers according to the curriculum objectives and evaluation standards. Reflection and evaluation of their own learning process and outcomes, as well as evaluation of their peers' learning, can promote students' self-directed learning and mutual learning, and develop their critical thinking and evaluation skills.

5. Conclusion

To sum up, the construction of computer courses based on the CBE-CDIO engineering education concept can better cultivate students' comprehensive skills and practical skills. With the continuous progress of science and technology and the change of engineering practice needs, colleges and universities also need to continuously optimize the course content and teaching methods to keep pace with the times, and promote and apply the CBE-CDIO concept in more computer courses. In the future, it is expected that the construction of computer courses based on the CBE-CDIO concept can continue to develop, so as to cultivate more engineering talents with practical operation skills and team cooperation and provide more competitive human resources for society and the industry.

Disclosure statement

The authors declare no conflict of interest.

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