Academic Education Publishing House
Occupation and Professional Education Vol. 2 No. 3, 2025

Practice Teaching Innovation of Computer Science Majors in the Context of Engineering Education Accreditation

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Abstract: With the continuous promotion of engineering education accreditation, computer science majors have put forward higher requirements for students' comprehensive quality, especially practical ability and innovative spirit. This paper combines the current teaching practice in colleges and universities, analyzes the problems in practice teaching in depth, and puts forward systematic reform suggestions from the aspects of course content, teaching form, platform construction and industry-teaching collaboration. Through the comprehensive analysis of typical college cases and policy orientation, it explores the sustainable and effective teaching innovation path to provide reference and reference for computer science majors to cultivate high-quality engineering talents.

Keywords: Engineering Education Accreditation; Computer Science Major; Practical Teaching; Industry-Teaching Integration

1. Introduction

Since China officially became a full member of the Washington Agreement in 2016, engineering education accreditation has been comprehensively rolled out in China's colleges and universities, and its core concepts of "student-centered, output-oriented, and continuous improvement" have profoundly influenced the direction of the teaching reform of all kinds of engineering majors. Especially in computer science majors, with the rapid development of artificial intelligence, big data, edge computing and other technologies, how to cultivate composite talents with a solid theoretical foundation and the ability to solve practical problems has become a challenge that educators must face.

In recent years, the Ministry of Education has issued important documents such as the Guidelines for the Construction of Civics and Politics in Higher Education Courses and the Strategic Action for Digitalization of Education, which clearly put forward the promotion of the in-depth integration of information technology and education teaching, and the construction of a high-quality education system. In this context, practice teaching as an important part of talent training, its content and method must keep pace with the development of the industry, and truly realize "teaching with doing, doing with thinking, thinking with creation".

Although some colleges and universities have carried out preliminary reform attempts, but from an overall point of view, practice teaching still exists in a single project, lagging platform, unsound mechanism and other problems, it is difficult to comprehensively enhance the practical and innovative ability of students. Therefore, it is necessary to put forward a scientific and reasonable teaching innovation path on the basis of analyzing the problems to meet the development requirements of engineering education in the new era.

2. Status and Challenges

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2.1 Initial Exploration and Existing Problems

At present, many colleges and universities have tried to introduce practical teaching methods such as PBL (Project-Based Learning) project-driven teaching, open laboratories, and cross-specialty curriculum integration. For example, Beijing University of Posts and Telecommunications (BUPT) and Huawei jointly built an experimental class for ICT innovation talents, and Zhejiang University introduced a digital twin experimental platform that combines "reality and reality", which have achieved initial results. But at the same time, the following problems have also been exposed:

a)Shallow projects, lack of depth and continuity: some of the curriculum projects lack the support of real scenarios, and students are mostly oriented to "complete the task", ignoring the cultivation of engineering thinking.

b)University-enterprise cooperation is superficial and the synergistic mechanism is not sound: most of the cooperation is limited to equipment donation or short-term lectures, and there is a lack of curriculum co-construction and talent co-education mechanism.

c)Teachers' guidance ability varies: some teachers lack practical experience in enterprises or engineering background, which makes it difficult for them to provide high-quality technical guidance for students during the project.

2.1 Constraints on Teaching Resources and Mechanisms

High-quality practical teaching cannot be separated from solid resource support and perfect teaching mechanisms, but many colleges and universities are still facing constraints in the following aspects:

a)Practical course system lags behind: there is a "time gap" between the existing curriculum and the development of industrial technology, and new technologies cannot be incorporated into the teaching content in time.

b)Weak experimental conditions: some universities have aging laboratory equipment and incomplete software authorization due to the limitation of funding or management mechanism, which limits the implementation of complex projects.

c)Single assessment method: most of the courses are still assessed by "project acceptance" or "defense score", and lack of comprehensive evaluation of teamwork, innovative ideas, engineering realization and other dimensions.

3. Proposed Reform Path

In order to solve the problems existing in the current practice teaching, this paper puts forward systematic reform suggestions from the following five aspects:

3.1 Optimize the Design of Course Content

The course content is the core of practice teaching, and its quality directly affects the students' interest in learning and ability growth. The design should be optimized in the following aspects:

a)Keeping up with the technology frontier: typical application tasks in emerging fields such as artificial intelligence, blockchain and edge computing are introduced into the practical courses, such as "face recognition system development" and "blockchain smart contract design";

b)Highlighting comprehensiveness and design: strengthening multi-module collaborative projects, such as "smart home system design" and "campus IoT platform development", so that students can master systematic thinking in completing the projects;

c)Supporting curricular integration: encouraging cross-disciplinary projects such as "Computer + Education" and "Computer + Biology" to break down disciplinary barriers and enhance the ability to solve complex problems.

3.2 Innovative Forms and Methods of Teaching and Learning

Teaching methods are key to the ability of students to gain real competence. Suggestion:

a)Implement task-driven and problem-oriented teaching: the course is designed with the real needs of enterprises, such as combining with the construction of local smart cities to carry out the "development of urban transportation simulation system";

b)Introduce flipped classroom and blended teaching: theoretical content is learned online, and classroom time is focused on project discussion and practical guidance to improve teaching efficiency;

c)Strengthening the "integration of competition and education": through the curricula of Blue Bridge Cup, Internet+ and other competitions, students' project awareness and competitiveness are enhanced.

3.3 Strengthen the Construction of Practice Platform

Practice platform is the "carrier" of practice teaching, which needs to be continuously constructed and upgraded:

a)Laboratory modernization: focusing on the construction of cloud computing experimental platform, virtual simulation experimental system, etc., to solve the problem of insufficient equipment and multi-location coordination;

b)Construction of "Smart Creative Space": equipped with 3D printing, embedded development platform, etc., encouraging students to conduct open and innovative experiments;

c)Co-construction of industrial practice bases: Relying on leading enterprises, we have set up long-term practical training sites outside the university to realize the cultivation of abilities under the "real environment".

3.4 Establish a Multi-Dimensional Evaluation and Incentive Mechanism

A scientific evaluation and incentive system helps to guide the overall development of students:

a)Construct a multi-dimensional evaluation model: covering dimensions such as project plan, team division of labor, results presentation, process reflection, etc. Promote results transformation evaluation;

b)Promote the evaluation of achievement transformation: incorporate the prototypes, patents, application systems, etc. formed by students in the practical projects into the academic evaluation system;

c)Setting up practice honor and innovation credits: giving notification and commendation and credit conversion to students with outstanding performance, so as to enhance the sense of acquisition.

3.5 Deepen the Mechanism of Industry-Teaching Synergy

Effective industry-teaching integration is an important path to improve the quality of practical teaching:

a)Enterprises are deeply involved in the whole process of teaching: they participate in the design, implementation and evaluation of the curriculum and synchronize the content with the industry;

b)Establishment of "dual-mentor" system: establish a joint mentoring team consisting of on-campus teachers and enterprise engineers to improve the practical applicability of the project;

c)Promote the incubation and transformation of achievements: excellent projects are supported to apply for patents and docked with incubation platforms in science and technology parks to extend the talent training chain.

4. Typical Case Analysis

Case 1: Construction of "Smart Campus" Curriculum Group in a Southern University

Relying on the theme of "Smart Campus", the university has opened up a number of courses, such as "Embedded System Design", "Internet of Things Technology Fundamentals" and "Project Management", and implemented the teaching organization model of "Curriculum Group + Project Driven". The school relies on the theme of "Smart Campus" to open up a number of courses, including "Embedded System Design", "Internet of Things Technology Basics" and "Project Management", and implements the teaching organization mode of "Course Cluster + Project Drive". Students work in groups to carry out projects such as "Campus Electricity Intelligent Management System" and "NFC-based Authentication System", covering the whole process from requirement analysis, system design to prototype development.

Results Analysis:

a)The pilot application of the project in the school logistics system has enhanced students' understanding of the "engineering-oriented project life cycle";

b)Two software copyrights were obtained for the practical project results, and the students' sense of innovation was significantly enhanced;

c)Reflecting the concepts of "output orientation" and "continuous improvement" of engineering education accreditation.

Case 2: A university in central and western China built a "5G innovation lab" with ZTE Corporation

The university took the opportunity of the "double first-class" construction to build a 5G+edge computing joint lab with ZTE Corporation, and opened a "Frontier Technology Research and Development" course for senior undergraduates. The university took advantage of the opportunity of "double first-class" construction to set up a 5G+edge computing joint laboratory with ZTE Corporation. The laboratory offers a practical course on "Frontier Technology Research and Application" for senior undergraduates, arranges for enterprise engineers to participate in teaching and project guidance, and carries out research on topics focusing on the simulation of 5G communication protocols, optimization of video coding, and deployment of edge AI models.

Results Analysis:

a)Enterprises are involved in the design of the course programs, and part of the courses are completed in the enterprise bases to promote the "school-enterprise dual classroom";

b)More than 80% of the students were recommended for internships or practical training in technical positions after the courses;

c)A complete chain of "introduction of enterprise scenarios - integration of teaching process - output of project results" has been constructed, realizing the goal of "student-centered" practical teaching reform.

Case 3: A "doubly non-permanent" university in the east of China has built a "software engineering virtual teaching factory"

The university makes full use of virtual simulation technology and independently develops a "software engineering teaching factory platform" to simulate the enterprise-level project management process. It simulates the enterprise-level project management process. The platform takes real roles, task assignment and collaborative development as the core, sets up project initiation, version iteration, code review and other links, and embeds courses such as “Software Engineering”, “Database System” and “Human-Computer Interaction”.

Results Analysis:

a)The platform simulates the development environment of a real enterprise, and students strengthen their engineering awareness in “role-playing”;

b)The platform has served more than 500 students, and teachers' teaching process is automatically recorded, providing data support for process evaluation;

c)The platform has served more than 500 students and automatically recorded the teaching process of teachers, providing data support for process evaluation. It promotes the implementation of “continuous improvement” in practical teaching and solves the problems of difficult evaluation and untraceable process.

Case 4: A university in Beijing enhances students' engineering ability through “competition embedded in teaching”.

The university incorporates national events such as the Blue Bridge Cup, Internet+ and China Software Cup into the content of courses such as “Comprehensive Practical Training” and “Programming Comprehensive”, and the teachers organize the resources of the competition in advance, and organize students to prepare for the competitions by selecting topics according to the project-based group. After the competition, results display, technical review and experience summary are carried out and incorporated into the course performance evaluation system.

Analysis of results:

a)The deep integration of teaching and competition enhances students' hands-on ability and engineering project management ability;

b)Students have won more than 60 awards at the municipal level and above, and the satisfaction of the course has increased significantly;

c)Through the combination of competition and teaching, a diversified practical training mechanism of “promoting learning, teaching and creation through competition” has been built.

5. Conclusion

The reform of practice teaching in computer class is a systematic and long-term educational project. In the context of the deep integration of engineering education certification and industry, colleges and universities need to be problem-oriented and gradually establish a scientific, systematic and sustainable practice teaching system. Based on analyzing the current problems, this paper proposes a number of reform paths in terms of content, methods and mechanisms. In the future, it is necessary to further strengthen the policy support, resource coordination and cross-sectoral collaboration, and continuously promote the integration of “teaching, learning and doing” reform, so as to lay a solid foundation for the high-quality training of computer engineering talents in China.

Acknowledgments

This paper is supported by Higher Education Teaching Reform Research Project of Hunan Province(No. HNJG-20231034).

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