Exploration and Practice of Computer Network Curriculum Construction for Interdisciplinary Integration under the New Engineering Background

Qianchen Yang*
School of Computer and Information Engineering, Guangxi Vocational and Technical Normal University, Nanning, Guangxi, China
**Corresponding Author.*

Abstract: The introduction of new engineering construction and the concept of interdisciplinary integration provides new solutions to the dilemmas faced in engineering talent cultivation and curriculum construction. Based on an in-depth analysis of the connotations of new engineering and interdisciplinary integration, this paper takes the computer network course as an example and proposes a computer network curriculum construction model based on OBE (Outcome-Based Education) and PBL (Problem-Based Learning). This model is guided by practical applications and aims to create a three-wheel-driven course objective system of "knowledge + ability + quality"; it completes the "six-step guided learning" of "setting—guiding—thinking—researching —practicing—analyzing" with problem scenarios as the main line; it implements "industry-university-research-creation" four-combination teaching activities based on internal and external collaboration; it achieves diversified comprehensive teaching evaluation based on teaching objectives; and it realizes multi-dimensional holistic education by integrating mindful and ethics elements. This curriculum model can provide reference for the construction of related courses.

Keywords: New Engineering; Interdisciplinary Integration; Computer Network; Curriculum Construction

1. Introduction

In today's era of information technology, the role of computer networks as a supporting system for information technology cannot be ignored. In 2014, the Central Network Security and Informatization Leading Group proposed that build China from a "network giant" into a "network power," a change in wording that carries profound implications. Over the past decade, under the guidance of important thoughts on network power, universities across China have strengthened the cultivation of network talents. The cultivation of network talents is inseparable from the study of network professional knowledge, and "Computer Networks" as one of the most important professional foundational and core courses, is thereby endowed with a glorious mission and responsibility. However, through research, it is found that the "Computer Networks" course generally has the following problems in the teaching process: the course is highly theoretical and difficult to learn; the network develops rapidly and industry demands change; there is a disconnection between theory and practice and a lack of innovation ability; emphasis is on content learning while ethics education is insufficiently integrated; assessment and evaluation are simple and the effectiveness is not well reflected. The existence of these problems is mainly because the traditional discipline-oriented education concepts and teaching models cannot meet the requirements of network professional talent cultivation in the new situation. How to solve these dilemmas? The proposals of new engineering construction and interdisciplinary integration provide new paths for the construction of computer network courses.

2. Relevant Concepts of New Engineering and Interdisciplinary Integration

2.1 New Engineering

The concept of "New Engineering" originated from the Washington Accord in 2016 and has undergone the construction trilogy of the "Fudan Consensus," "Tianjin Action," and "Beijing Guide." Currently, the construction of New Engineering is in full swing, opening up new paths for engineering education reform.

Many scholars in China have expounded on the concept and connotation of "New Engineering" from different perspectives. Lin [1] pointed out that "New Engineering" should break through the definition of traditional engineering, giving it new connotations that transcend disciplinary and industrial boundaries to meet new developmental needs, thus achieving new transformations in emerging, new, and novel aspects of engineering. Zhong [2] believes that the connotation of New Engineering construction is to cultivate diverse and innovative outstanding engineering talents, guided by the principle of fostering virtue and morality. Gu [3] argues that the "new" in New Engineering not only refers to new engineering disciplines but also includes new requirements for existing traditional engineering disciplines, with talent cultivation being market-oriented. Zhao et al. [4] proposed the characteristics of New Engineering, such as comprehensiveness, foresight, interdisciplinarity, openness, and practicality. In summary, from the perspective of talent cultivation, New Engineering education is a new educational concept guided by fostering virtue and morality, with interdisciplinarity and integration as the main pathways to cultivate diverse and innovative outstanding engineering talents.

2.2 Interdisciplinary Integration

In today's society, the mutual penetration and integration of industries have become a new trend. Simultaneously, the educational goal of New Engineering is to cultivate diverse and innovative engineering talents, which requires the cultivated talents to have interdisciplinary abilities. Therefore, in cultivating New Engineering talents, it is necessary to break down disciplinary barriers and achieve interdisciplinary integration.

Interdisciplinary integration, in a narrow sense, refers to the mutual penetration and integration of two or more different disciplines to form a new comprehensive disciplinary system, thereby cultivating high-quality interdisciplinary talents with multiple abilities. In a broad sense, interdisciplinary integration not only involves the mutual integration of different disciplines but also includes the cross-integration of personnel and platforms involved in multidisciplinary training, such as putting together faculty, laboratories, centers, and other resources related to talent cultivation. Currently, under the New Engineering background, multidisciplinary integration has become a research focus in universities.

2.3 The Relationship between New Engineering, Interdisciplinary Integration, and the Computer Network Course

(1) The Relationship between New Engineering and the Computer Network Course

As a typical engineering discipline, the computer network course suffers from various drawbacks of traditional engineering education in China. Traditional discipline-oriented educational concepts and teaching models cannot meet the requirements of network professional talent cultivation in the new situation. In contrast, New Engineering emphasizes market orientation and adopts new concepts, new requirements, and new pathways of engineering education models, providing new paths to break the drawbacks of traditional engineering education.

(2) The Connection between Interdisciplinary Integration and the Computer Network Course

As a general technology, computer networks are widely applied in many fields. The computer network course is integrated into the curriculum systems of other disciplines such as IoT engineering, artificial intelligence, and e-commerce. At the same time, as a product of the combination of computer technology and communication technology, the computer network course itself involves multiple disciplinary contents and has strong interdisciplinary characteristics.

3. Construction of Computer Network Curriculum Oriented to Interdisciplinary Integration under the New Engineering Background

From the aforementioned connotations of New Engineering and interdisciplinary integration, as well as the relationship between New Engineering, interdisciplinary integration, and the computer network course, it is not difficult

to find that constructing the computer network course oriented to interdisciplinary integration under the New Engineering background can solve the current problems faced in curriculum construction. Therefore, based on the concepts of New Engineering and interdisciplinary integration, it is proposed to construct the "Computer Networks" course using an OBE-based PBL teaching model.

3.1 OBE and PBL

(1) OBE

Outcome-Based Education (OBE) [5-7], as a popular engineering education concept, is widely applied in New Engineering construction. The biggest difference between it and traditional discipline-oriented education is that OBE takes students' learning outcomes and acquired abilities as teaching objectives and constructs the curriculum system inversely based on these objectives. In other words, the curriculum system is constructed based on market demands and industry capability requirements. This approach can better address the disconnection between theory and practice in traditional computer network courses and the mismatch between the professional knowledge learned in school and the talents needed by society.

(2) PBL

Problem-Based Learning (PBL) [8-10] is a teaching model that revolves around specific teaching objectives related to course knowledge points. By setting complex, real, and meaningful problem scenarios, and under the guidance of teachers, through interactive teaching both inside and outside the classroom, students are guided on how to effectively solve problems from these scenarios. This model comprehensively enhances students' knowledge theoretical levels, problem-solving skills, and independent learning abilities.

3.2 Construction of a Computer Network Curriculum System Based on OBE and PBL

Under the guidance of New Engineering construction and interdisciplinary integration concepts, the computer network curriculum system is reconstructed based on OBE and PBL, as shown in Figure 1. Specifically:

First, following the OBE outcome-oriented concept, the curriculum system is constructed inversely from market demands and student outputs. This means conducting research on the employment needs of relevant organizations, clarifying the market's ability requirements for network talents, and using this as a basis to outline professional talent cultivation objectives, clarify graduation requirements for students, and compile the capability matrix of the professional training program. This ensures that the courses offered align with market demands.

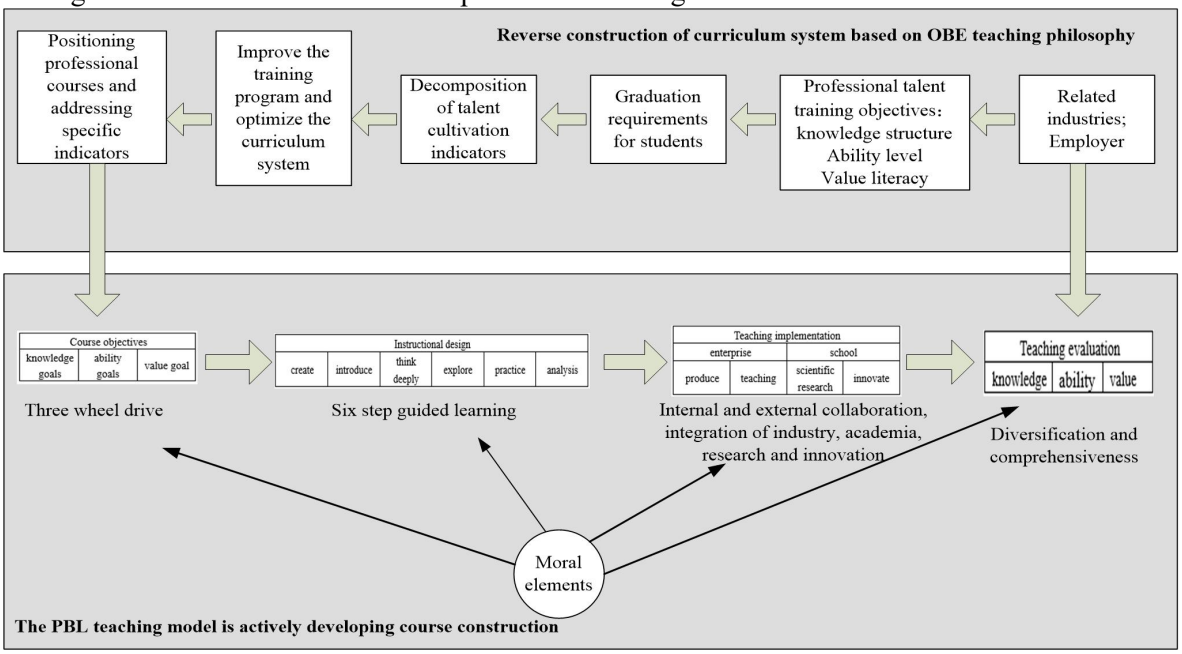

Figure 1. Computer Network Curriculum System Based on OBE and PBL

Secondly, once the course objectives of "Computer Networks" in terms of knowledge, abilities, and values within the talent cultivation system are clarified, the PBL

teaching model can be used to construct the course according to these teaching objectives and requirements. By using the "Six-Step Guided Learning" method of "Setting—Guiding—Thinking—Researching —Practicing—Analyzing" in teaching design, students are guided to engage in teaching interactions, actively explore practical problems, and through the collaboration between school and enterprise, the "industry-university-research-creation" four-in-one teaching activities are implemented. The evaluation of the course teaching effect fully considers the process, adopts diversified and comprehensive evaluation methods, and integrates mindful and moral elements throughout the entire teaching process, returning to the essence of education.

(1) Guided by Practical Applications, Creating a "Three-Wheel Drive" Course Objective System

According to the core requirements of OBE's "outcome-oriented" concept, the talent cultivation plan is determined, and the talent cultivation indicators are decomposed into corresponding courses. Based on this, the objectives of the "Computer Networks" course are set. When designing course objectives, in addition to considering the knowledge objectives in traditional courses, the objectives also take into account the ability and quality goals in combination with engineering teaching concepts, effectively connecting the three. This forms the educational objectives centered on the concept of "building a network power," ensuring the "knowledge + ability + quality" three-wheel drive for students. The realization of these three objectives reflects the course's demand for multiple disciplinary abilities, which cannot be achieved by solely relying on the teaching of knowledge points in the computer network course. This necessitates the integration of learning from other disciplines during the course teaching process, embodying interdisciplinary integration.

(2) Using Problem Scenarios as the Main Line to Complete the "Six-Step Guided Learning" Teaching Design

Teaching design is the foundation of teaching implementation, determining the direction and effect of teaching. In the PBL teaching model, the "Computer Networks" course takes the setting of problem scenarios as the main line and adopts the "Six-Step Guided Learning" method of "Setting—Guiding—Thinking—Researching —Practicing—Analyzing" for teaching design. Among them, "Setting" refers to "creating scenarios," combining teaching content with corresponding practical application scenarios to stimulate students' interest in learning; "Guiding" refers to "introducing cases," where appropriate cases are chosen to integrate knowledge points into the teaching process to avoid the monotony of knowledge point lectures; "Thinking" refers to "encouraging thinking," as innovation comes from thinking, encouraging students to ask more questions and think more; "Researching" refers to "exploring principles," where students should not just memorize but explore the principles behind phenomena; "Practicing" refers to "strengthening practice," as the computer network course is highly practical and requires much practice; "Analyzing" refers to "summarizing and analyzing," where students should be adept at summarizing and analyzing to draw inferences from one instance to another.

(3) Implementing "Industry-University-Research-Creation" Four-Combination Teaching Activities Based on Internal and External Collaboration

The goal of OBE education under the New Engineering background is to align students' outputs with market demands. This requires that the implementation of course teaching activities should not solely rely on the classroom but should extend to enterprises, adhering to the combination of production, teaching, research, and innovation, and achieving internal and external collaboration.

(4) Achieving Diversified and Comprehensive Teaching Evaluation Based on Teaching Objectives

Traditional course assessment models are result-oriented, usually taking theoretical exams as the evaluation outcome. This leads some students to neglect the usual learning process, focusing mainly on the final theoretical exam, which does not meet the requirements of cultivating applied talents in New Engineering. Therefore, the computer network course uses the knowledge, ability, and quality objectives in the course teaching objective system as the evaluation guide and adopts a diversified, whole-process assessment

model. Besides traditional theoretical exams, online self-study, group discussions, practical operations, and other factors are also considered.

(5) Using the Integration of Moral Elements as an Opportunity to Achieve Multi-Dimensional Whole-Process Education

The realization of the value objectives of the computer network course determines that, besides cultivating students' theoretical knowledge and practical abilities, the course should also help students establish correct values. This necessarily involves integrating ethics education elements into the course, combining the computer network course with mindful and moral courses and elements to achieve the goal of whole-process, all-round education.

4. Conclusion

New engineering construction and interdisciplinary integration provide a new direction for training engineering talents who meet the needs of The Times. On the basis of in-depth analysis of the connotation of cross-integration of new engineering and disciplines, this paper puts forward a computer network course construction model based on OBE and PBL, which is guided by practical application and builds a three-wheel driven curriculum target system of "knowledge + ability + quality". Taking the problem situation as the main line, complete the teaching design of "setup - introduction - thinking - research - practice - analysis" and "six-step guide"; On the basis of internal and external cooperation, the teaching activities of "production, learning, research and innovation" are implemented. Based on the teaching objectives, to achieve a diversified comprehensive teaching evaluation; Take the integration of moral elements as an opportunity to achieve multi-dimensional and whole-process education.

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