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Research on the Reform of University Computer Curriculum Based on OBE Concept--Taking Data Structure as an Example

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Abstract: The computer major in application-oriented undergraduate colleges focuses on cultivating students' practical ability to solve complex engineering problems in the field of computer science. Data structure, as a core foundational course in computer science, plays an important role in connecting the past and the future in the curriculum system. This article adopts the OBE concept, student-centered, and results-oriented, and proposes an overall plan for the reform of mixed online and offline courses in data structure. It optimizes teaching content, constructs a multi-dimensional course assessment and evaluation system, and strives to achieve the training goals for students from three levels of knowledge, ability, and quality.

1.Introduction

Data structure is not only a fundamental course in computer science and technology, but also a core course in computer science. It plays a connecting role in the computer curriculum system. Data structure is an important theoretical and technical foundation of computer programming, which focuses on cultivating students' ability to analyze data,store data and design algorithms for complex engineering problems, laying a solid foundation for the learning of compiling programs, operating systems, databases, and other related courses.

The data structure course mainly explains basic data structures such as linear tables, stacks, queues, strings, arrays, trees, and graphs[1][2], as well as different search and sorting algorithms[3]. It has multiple knowledge points, abstract content, and strong logic and practicality. Students generally reflect that the course is difficult to learn, especially in the practical stage, and there is no way to start. Therefore, the traditional teaching model that focuses on classroom teaching, teacher centered, and emphasizes theory over practice must be reformed.

Unlike traditional teaching methods, OBE (Outcomes Based Education)[4] emphasizes the abilities and levels that students possess after completing their studies. The concept of OBE was first proposed by American scholars and has been widely applied in educational reform in Western countries. Its core idea is student-centered and result oriented goals. This concept takes graduation requirements as the starting point, reversely designs matching teaching syllabus, teaching content, and teaching methods, and evaluates learning outcomes to achieve continuous improvement.

The computer major in applied undergraduate colleges focuses on cultivating students' practical ability to solve complex engineering problems in the computer field, which is consistent with the OBE education philosophy. Therefore, this article utilizes the OBE teaching concept to implement teaching reform for the data structure course, which can improve students' ability to apply theoretical knowledge to solve practical application problems and achieve the goal of optimizing teaching.

2.The overall architecture of data structure reform based on OBE concept

The overall architecture of the data structure curriculum reform based on the OBE concept is shown in Figure 1.

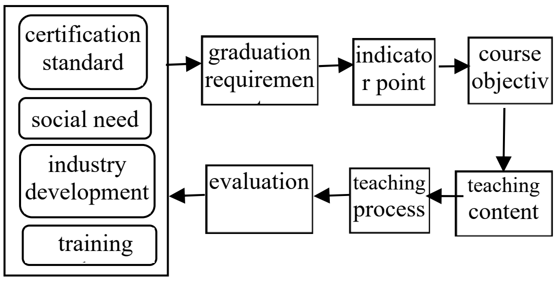

Figure 1. The overall architecture of the data structure reform based on the OBE concept

Firstly, in accordance with the certification standards for engineering education [5], combined with social needs, the latest developments in the industry, and the talent training plan for computer science and technology [6], determine the graduation requirements; Identify the graduation requirement indicators that need to be supported by the data structure course in the computer major system by comparing the 12 graduation requirements for engineering certification; Furthermore, based on the OBE concept, establish the teaching objectives of the data structure course, and establish the corresponding relationship between the course objectives and graduation requirements indicator points; Next,

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carefully analyze the set course goals, clarify the knowledge points required to achieve each course goal, and determine the teaching content, refining the course goals supported by each chapter; Then, in the process of teaching implementation, various teaching methods and means should be reasonably utilized, adopting a mixed online and offline teaching mode. In addition to text, a multimodal teaching mode combining sound, animation, and audio video should be introduced, and various teaching methods such as heuristic and case studies should be used to guide students to actively learn, thereby achieving the initially set course objectives; Finally, develop corresponding assessment and evaluation systems based on course objectives to measure students' ultimate learning outcomes; Analyze results, identify issues, and continuously improve. Course objectives - teaching content - teaching implementation - assessment and evaluation, forming a complete closed-loop teaching process, with clear training objectives, monitoring mechanisms for the teaching process, and evaluation mechanisms for the achievement of course objectives, forming a virtuous cycle and continuous improvement.

3.Detailed scheme design

3.1.A. Reverse design teaching content based on OBE concept

According to the certification standards for engineering education, the graduation requirements in the talent training program for computer majors are refined into 34 secondary indicator points. The data structure course provides support for four indicator points, focusing on cultivating students' engineering knowledge, analytical ability, design ability, research and application ability. After determining these indicator points, we set 4 corresponding course objectives (as shown in Table 1).

Table 1. Graduation requirements indicators supported by the data structure course objectives

Graduation requirements	Indicator point	Course objectives
1.Engineering knowledge: Able to apply mathematics, natural sciences, engineering fundamentals and professional knowledge to solve complex engineering problems in computer application systems.	Indicator point 1.2: Able to establish mathematical models for specific engineering problems in computer application systems and solve them.	Be able to understand the logical structure and storage structure of basic data structures such as linear tables, stacks, queues, strings, arrays, trees, and graphs, as well as their advantages and disadvantages.
2.Problem analysis: Able to apply the basic principles of mathematics, natural sciences, and engineering sciences, as well as professional knowledge in computer science to express and analyze complex engineering problems in computer application systems in order to obtain effective conclusions.	Indicator point 2.2: Able to abstract and model complex engineering problems in computer application systems based on scientific principles and mathematical modeling methods.	Be able to analyze the design methods of typical data structures such as linear tables, stacks, queues, strings, arrays, trees, graphs, etc. as well as the performance and design methods of various search and sorting algorithms.
3.Design/Develop Solutions: Able to design solutions for complex engineering problems in the field of computer applications, design computer application systems that meet specific needs, reflect innovation awareness in the design process, and comprehensively consider social, health, safety, legal, cultural, and environmental factors.	Indicator point 3.1: Master the relevant design and development methods and techniques for complex engineering problems in computer application systems, and understand various factors that affect design goals and technical solutions.	Be able to comprehensively apply the basic principles of data structure, select and design appropriate data structures and algorithms for complex engineering problems in specific computer fields, and then design a simple computer application system.
4.Research: Able to study complex engineering problems in computer application systems based on scientific principles and methods, design and implement experimental plans, analyze and interpret experimental data, and obtain reasonable and effective conclusions through information synthesis.	Indicator point 4.1: Able to investigate and analyze solutions to complex engineering problems in computer application systems based on scientific principles through literature research or relevant methods.	Capable of studying complex engineering problems in computer application systems based on the basic principles of data structure, selecting suitable programming tools, designing experimental schemes, and providing a complete source program implementation .

Deeply analyze the knowledge points required for each course objective, revise the teaching outline, update the knowledge system, and in addition to describing the knowledge points, key points, difficulties, and class hours of each chapter, clarify the knowledge requirements, ability requirements, quality requirements, teaching methods used, and the course objectives supported by this chapter in the outline.

3.2.B.Adopting the BOPPPS teaching design method

The BOPPPS method[7] consists of 6 links:Bridge-in、Outcome 、 Pre-test 、 Participation 、 Post-test and Summary.

During the teaching process, the outcome and pre-test will be arranged in the online environment of the Wisdom Tree; The two stages of bridge-in and participation are conducted in offline classrooms; The post-test and summary are conducted through a combination of online and offline methods, introducing KeTangPai and online judge platforms for chapter content testing and online experiments.Students are subjectively evaluated through questionnaire stars, while also cooperating with offline assignments and summaries. The teaching mode framework is shown in Figure 2.

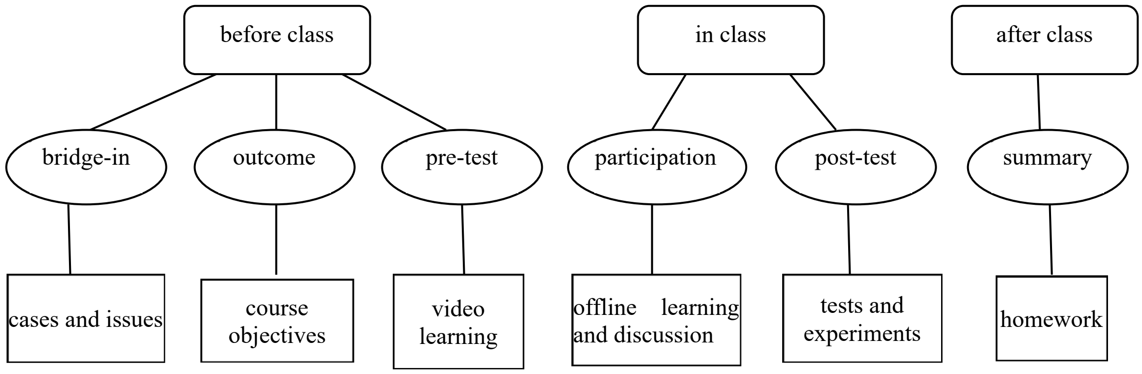

Figure 2. Teaching design based on BOPPPS method

The implementation of course teaching is divided into three processes: pre class, during class, and post class.

Before class: Teachers develop course teaching objectives based on the OBE concept, and determine the graduation requirement indicator points supported by each course objective; Upload online learning resources on the Wisdom Tree platform, including teaching outlines, teaching plans, courseware, videos, exercises, etc; Upload experimental questions on the online judge platform; Then publish the task; Students independently engage in online video learning according to task requirements, understand course content, and document existing problems.

In class: Theoretical teaching condenses knowledge points through centralized offline classroom teaching, provides precise lectures on key and difficult points, and provides centralized Q&A on common problems that exist in students' learning process, inspiring students to further deepen their thinking; Basic experiments and innovative experiments are adopted in experimental teaching, and this hierarchical and progressive experimental model is used to meet students' personalized needs and strengthen the cultivation of their practical application abilities. After each chapter, conduct online testing on the KeTangPai platform and complete the experimental questions assigned by the online judge platform.

After class: For complex engineering problems, the method of assigning large assignments is adopted, and students actively review literature and submit solutions. Finally, students effectively combine online and offline learning, both in and out of class, to summarize and review; Teachers conduct teaching evaluations and reflect on teaching in order to continuously improve.

The entire teaching process will organically integrate offline and online classrooms, and construct a blended online and offline teaching model. Combining case based, heuristic, exploratory, discussion based, and participatory teaching methods in teaching methods; In terms of teaching means, more vivid multimodal teaching materials are used, utilizing multimedia resources such as images, animations, and videos to stimulate students' multi-sensory reactions, making dull and abstract teaching content vivid , helping students better understand obscure algorithms, and enhancing their learning interest and enthusiasm.

3.3.Constructing a multi-dimensional curriculum evaluation system

The traditional data structure course evaluation methods mostly use the final exam scoring method to evaluate the teaching quality of the course, which is difficult to dynamically reflect the specific performance of students in the learning process. This article proposes a multi-dimensional curriculum evaluation system that integrates exam evaluation and process evaluation [8]. Process evaluation mainly assesses and evaluates students' performance in online and offline learning activities, including attendance, classroom tests, homework completion, experimental completion results, video viewing time, and participation in discussions. Process evaluation accounts for 50% of the total score; The evaluation of the exam is completed through the final exam, accounting for 50% of the total score. The evaluation methods are diversified, including student self-evaluation, intra group mutual evaluation, inter group mutual evaluation, teacher evaluation, questionnaire survey, and other methods. The entire evaluation system focuses on controlling and evaluating students' learning process, allowing for timely understanding of each student's learning status and problems in course learning, and personalized teaching. The assessment and evaluation methods for data structure courses are shown in Table 2.

Table 2. The evaluation methods for data structure

evaluation classification	assessment method	score proportion	evaluation basis
process evaluation	offline activity performance	10%	answering questions, completing assignments
	testing	10%	chapter testing, KeTangPai record
	online activity performance	10%	video learning, online discussions ,Wisdom Tree record
	experimental completion status	20%	laboratory report
exam evaluation	final exam	50%	teacher review
comprehensive evaluation		100%	

4.Conclusions

This article is based on the OBE concept, with students as the main body and output oriented. Based on the certification standards of engineering education, social needs, and computer professional talent training plans, it comprehensively explores and practices the teaching reform of data structure courses from various aspects such as teaching syllabus, course content, teaching mode, and assessment evaluation. The focus is on cultivating students' ability to comprehensively apply the basic principles of data structure to solve complex engineering problems in the computer field, Enable students to gradually develop professional qualities such as seeking truth, practicality, excellence, and innovation, laying a solid foundation for future work.

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