The Construction of Multi-dimensional Course Model

Take the Data Structure Course As an Example

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Abstract. Data structure course is the core course of electronic information and computer science majors, and it is also a mandatory course to cultivate new engineering majors with innovative consciousness and the ability of cross-fertilization of disciplines. Aiming at the pain point problems faced in the teaching process of this course, students' weak foundation of data and computer programming, students' difficulties in understanding abstract algorithmic problems and test-based learning, and low motivation, we put forward the concept of "classroom integration", "practical", "case" and "two-wing" multi-dimensional classroom construction to guide the teaching innovation. Based on the OBE education teaching concept, we propose "classroom integration", "real cases" and "two-wing" multi-dimensional course construction, which enrich the course activities, increase students' interest in learning, change the test-oriented learning attitude and shape the correct values. The practice of teaching innovation shows that the multi-dimensional course model of nurturing people under the leadership of the new engineering discipline provides a useful reference for talent cultivation.

Keywords: Data structure; multi-dimensional course model; OBE education

1 Introduction

The content of the data structure course is relatively abstract, it is difficult for students to establish a connection with real-life problems, and they are unable to carry out practical observation, and there is a certain degree of difficulty in the understanding of the knowledge points. The knowledge of this course needs to be combined with practice, on the basis of these basic algorithms and various comprehensive applications[1][2], but at present students have fewer opportunities to practice. This results in some students can understand the algorithms, but the ability to code and realize the algorithms is still to be improved, so when encountering practical abstract problems, it is difficult to establish a link with the basic algorithms and hands-on realization.

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Teacher and student interaction in the classroom is formalized, with low student participation, low motivation and low effectiveness. The course is evaluated by means of an examination and a combination of usual performance. However, the usual performance scoring standards are not specific enough, and the evaluation process lacks the evaluation of the ability of students to actually obtain through this course, so students are not highly motivated to learn in the usual learning process, test-based learning, and think that reviewing before the exam will be enough[3][4]. This approach also has an adverse effect on the teaching of the classroom over time.

2 Teaching Reform Idea

2.1 Restructuring Course Content

This course is closely related to the students' basic courses in mathematics and computer science, so the content of the course is reconstructed to build a "classroom integration" classroom between data structures and mathematics[5], and between data structures and computer language, to build a bridge between the students' understanding of mathematical concepts and the knowledge of this course, which will help to help them to understand the knowledge of the course[6], and to deepen their understanding of the extended application of other mathematical knowledge, and to build a completed knowledge map. It helps students to understand the concepts of this course[7], deepen their understanding of the application of other mathematical knowledge, and build up a completed knowledge map.

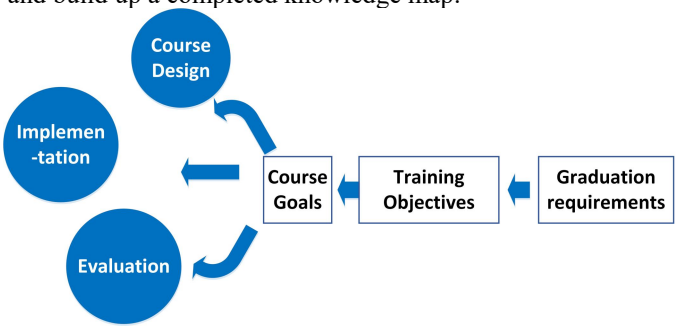

Fig. 1. OBE Education Philosophy

As shown in Figure 1We base our instructional design on learning objectives and adapt our teaching methods based on effectiveness[8].The course is closely connected with the field of artificial intelligence, linking the basic knowledge points with current application hotspots to stimulate students' enthusiasm; although the content of this course focuses on the storage and application of data, the computer programming language, as its tool, also plays an important role in verifying the knowledge concepts, and therefore should not be ignored[9][10].

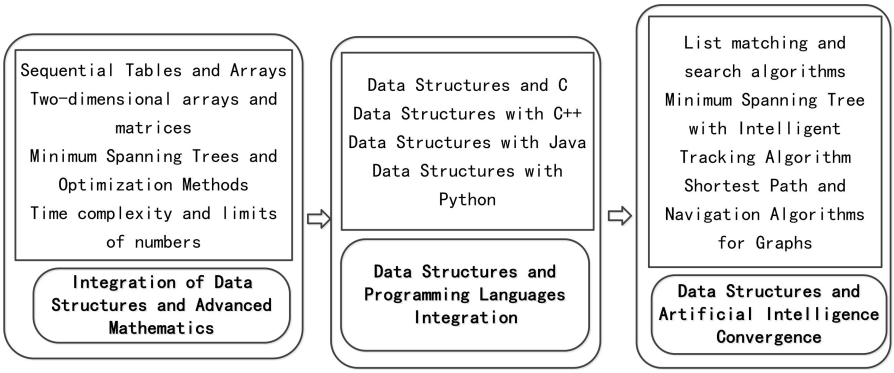

Fig. 2. The implementation of restructuring course content

As shown in Figure 2, the organic integration of mathematics and computer content into the classroom, creating integrated classroom activities, not limited to the knowledge system of the course, expanding the dimensions of the teaching content, and forming a multidimensional classroom with the integration of "Data Structure + Mathematics", "Data Structure + Programming Language", and "Data Structure + Artificial Intelligence" are conducive to helping students build the entire knowledge system of the profession, expanding students' scientific horizons, and cultivating a universally connected way of thinking and scientific attitudes.

2.2 Decomposition Practice Problems

The knowledge content of this course is rather abstract, and the connection between the way data are stored in the computer and practical problems is difficult for students to understand. The teaching objectives require students to be able to master basic data structures and certain algorithmic ideas through this course, and to be able to utilize the basic structures they have learned to solve practical problems. Therefore, when carrying out teaching activities, the students' understanding of basic data structures and the use of basic algorithms to design and solve practical problems are taken as important objectives, to be able to analyze the basic data structures, to be able to transfer the knowledge learned to solve similar algorithmic problems at the end of the course.Therefore, to be able to achieve the teaching objectives, it is particularly important to strengthen students' understanding of data, enhance hands-on practice, and improve their programming ability and ability to analyze practical problems.

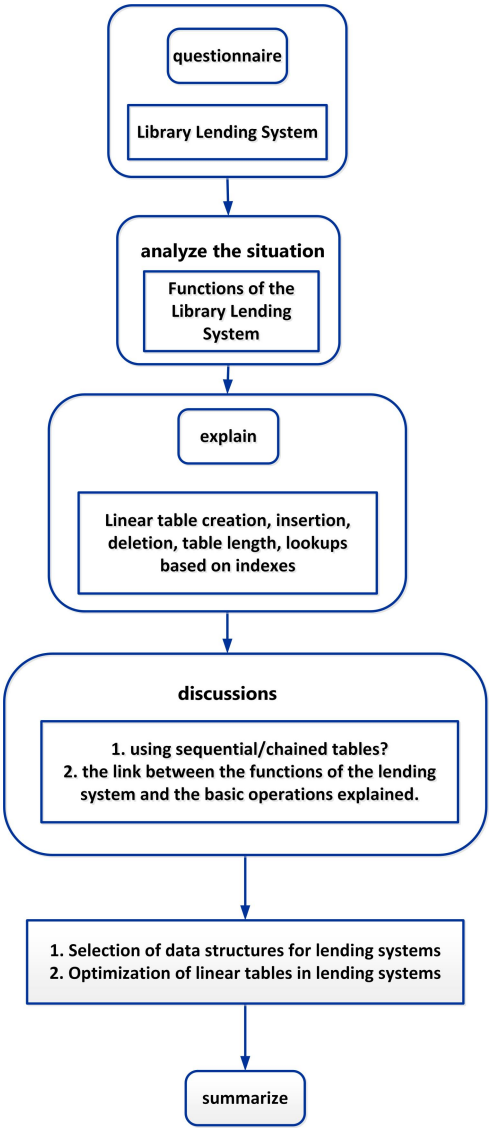

Fig. 3. Example of Decomposition of practical problems

Figure 3 shows the decomposition of the problem-guided teaching practice of the book lending system. Students collaborate to complete the programming of a library management system, focusing on analysis, discussion and practice, and decompose the functions into book in, book out, book price statistics, book quantity statistics, the most popular book statistics, book location query, etc. Everyone can divide the work into different subroutines and integrate different subroutines, which exercises the ability of system integration.

3 Teaching Reform Practice

3.1 Organizational Practice

The assessment method of the course is based on the teaching method and the criterion of training students. Adopting the process of assessment, student-centered, focusing on the usual assignments, discussions, activities, questions and answers, and student feedback, on the one hand, can strengthen the students' attention to the course, improve students' motivation to learn, and reverse the attitude of "test-type" learning; on the other hand, the assessment information and data can be used as part of the course's resources, providing data support for teachers' teaching analysis and continuous improvement. On the other hand, these assessment materials and data can be used as part of the curriculum resources to provide data to support teachers' instructional analysis and continuous improvement.

3.2 Reconstructing the Content of Instruction

Table 1. Relationship of group tasks to the knowledge points of the course

Table Head	Group tasks	
	The course content	***Tasks***
1	Insertion and Deletion Algorithms for Linear Tables	Books in and out
2	Stack	Check for Expression Operators
3	Stack/Queue	The Labyrinth's Solution
4	Queue	Hospital visit simulation
5	String	Detection of viruses
6	Tree and Binary Tree	Target tracking
7	Graph	Optimal path

Table 1 shows the evaluation composition of the course setting, the students' usual grades should be able to truly reflect the students' level, and the examination in teaching, can provide targeted guidance and correction of the students' examination. Teachers not only do a good job of teaching in the classroom, but also outside the classroom, a good guide for students to help students enter into a good state of learning, so that students are clear about their own problems and recognize the direction.

Make full use of information technology teaching tools to realize online assessment as well as the evaluation of the usual grades to help teaching innovation. The construction of the exercise bank for the course, the production of group papers for the chapters, and the setting of the grading of the group papers. Students can assess their mastery by answering questions online through the teaching software, and

teachers can quickly and objectively evaluate each student and learn about them through statistics.

3.3 Holistic Approach to Education

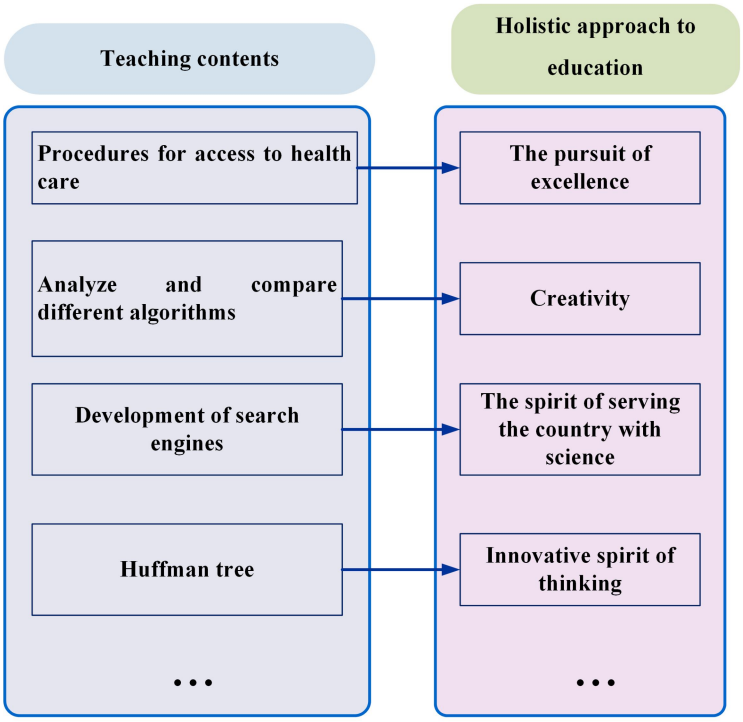

Fig. 4. Linkage between teaching methods and course content

As shown in Fig. 4, case-based teaching, creating situation mode, dialogue teaching and other methods are adopted in the teaching methodology to naturally internalize the core values of socialism, craftsmanship, and traditional culture into the teaching of course ideology and politics, and to establish the students' belief in strengthening the country with science and technology and serving the country with science and technology.

4 Efficacy of Reformation

4.1 Comparison Before and After Reform

Through pedagogical innovations and practices, students' interest and motivation in the course has increased significantly, and the overall semester grade for this course

has increased by nearly 10% in average after the implementation of classroom innovations, as well as a significant increase in the overall student proficiency rate.

Table 2. Type Styles

score band	Before reformation		
	number of people	*proportions*	*average score*
<60	10	21.74%	66
60-69	14	30.43%	
70-79	16	34.78%	
80-89	6	13.04%	
90-100	0	0	

Table 3. Type Styles

score band	After reformation		
	number of people	*proportions*	*average score*
<60	4	8.7%	72.15
60-69	9	19.57%	
70-79	10	21.74%	
80-89	20	43.48%	
90-100	3	6.52%	

The content of this course is related to the content of most disciplinary competitions in the specialty, and after the implementation of the innovation, students have developed a strong interest in the program and the specialty, and establish the spirit of scientific inquiry. Students actively participate in extracurricular academic competitions, and have won a number of national and provincial competitions such as Internet+, China Computer Design Competition, "Blue Bridge Cup", etc. Students' self-confidence has been significantly improved, which has also positively contributed to the professional training and education of talents. As shown in Table 2 and Table 3, the mode of "teaching for competition, teaching for learning" promotes teaching reform and innovation, and realizes the goal of new engineering teaching with multidisciplinary integration.

5 Conclusions

After three years of reformation practice, this course has been recognized as a first-class course .The practice of teaching innovation shows that the students' interest in learning has been enhanced and the multi-dimensional classroom model under the

leadership of new engineering disciplines provides useful reference for talent cultivation.

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