Experimental Teaching Reform of Data Structure Based on Seminar in the Major of Information Management and Information System

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Abstract: the Courses of Data Structure and Algorithm Application Are Difficult to Learn. in Order to Effectively Help Students to Understand Knowledge and Improve Their Ability to Use Knowledge, Based on the Teaching Ideas of Seminar, Experimental Teaching Goals and Teaching Plans Are Designed, Teaching Resources Are Established, from Experimental Case Discussion to Experimental Project Discussion and Practice. These Two Teaching Sectors Can Encourage Students to Study Independently and Collaborate to Solve Practical Problems. Teaching Practice Shows That Such Experimental Teaching Reforms Give Full Play to Students' Initiatives and Enable Students to Actively Participate in the Discussions of Experimental Analysis, Experimental Processes and Experimental Acquisitions, Which Can Create an Open and Free Learning Environment and Further Cultivate Students' Innovation Ability and Improve Their Comprehensive Skills and Comprehensive Quality.

1. Introduction

"Applications of Data Structure and Algorithms" is one of the core courses in the national quality standards for information management and information system majors. However, due to the wide content, abstract concepts and complex algorithm writing, students have certain difficulties in studying. The abstraction of knowledge makes students hardly know how to apply knowledge to practical problem solving. Therefore, how to improve the teaching method of data structure, how to enhance the effect of classroom teaching and experimental teaching, and how to enable students to learn more actively and apply creatively remain issues that teaching research should actively explore.

Seminar teaching method, also known as seminar-based teaching method, is a group discussion learning method that is different from the traditional lecture teaching method, which can bring into full play the students' learning potential and improve students' comprehensive abilities. As to the experimental teaching of the course of applications of data structure and algorithm, under the guidance of teachers, through self-learning and research, seminar teaching method can also be used to help the students become active, open and innovative in experiments.

This article takes the "Seminar" teaching method as the discussion core and aims to carry out reform practice in the aspects of experimental teaching goals, experimental teaching design, experimental teaching methods, experimental teaching process and experimental evaluation, etc., so that it is conducive to the cultivation of innovative talents applied to an innovative environment.

2. Design of Experimental Teaching Goals for Data Structure Courses

According to the teaching goals of pure engineering majors, such as computer science or communications engineering, the knowledge system and examples of data structure courses may be more biased toward pure programming and algorithms, and applications in operating systems, software engineering, computer networks, communications and electric circuits. However, as a specialty in the disciplines of management science and engineering, the information management major pays more attention to industry innovation and industry integration brought by the application

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of emerging information technology in the new engineering background, so as to cultivate students' ability to analyse and solve problems.

The teaching goals and tasks are to achieve the combination of theory and practical application, to present real problems through computers, so that students can design data organization and algorithms according to the characteristics of data, develop good software writing skills and improve the ability to solve practical problems, and moreover lay a certain theoretical and practical foundation for subsequent courses such as database system, computer network and social network analysis.

Therefore, we do not need to place much emphasis on programming skills during the design of experimental teaching goals of data structure, but focus on training students to use classic data structures and algorithms to solve social problems and management problems. The forms of experimental teaching employ case analysis and discussion based on Seminar, as well as the program practice of experimental projects. The choice of contents of experimental cases and experimental projects is mainly in queuing simulation, traffic planning, project management, production operation management, file similarity analysis based on word frequency, analysis, search and ranking of popular topics on Weibo, analysis of social network, and so on.

3. Design of Experimental Teaching Based on Seminar Teaching Method

Since there are fewer experimental lessons, classroom teaching can be incorporated to conduct discussions. The experimental cases can be used as opening or closing cases of each chapter, and experimental projects can be discussed again and implemented by programs to solve problems after the explanation of knowledge points and case discussions. Knowledge points are used to solve problems during teaching processes and they are not simple theories or methods. Therefore, teaching activities will also focus on discussions, paying more attention to the explanation and summary of the key points and difficult points of knowledge. These experimental cases are consistent with the content of the experimental projects. Not only can you find a method of resolution, but also design a debugging program to really solve the problem.

Considering that the main purpose of Seminar teaching is to enhance students' autonomous learning ability and research ability, promote students' bold participation in discussions and expand their knowledge. The experimental teaching seminar includes two parts, one is the discussion of classroom experimental cases and the other is the practice and discussion of experimental projects.

3.1 Discussing Experimental Cases in Class and Studying Experimental Cases after Class

As to the discussion of experimental cases in the classroom, based on the requirements of content, the teaching arrangement is that the cases are shown at the beginning or at the end of the classes. The students can have discussions in groups for 10 minutes, and then take 10 minutes for classroom discussions, and the group will explain how to use the data structure to solve practical problems. The students need to analyse that what the existing information is, what the problem is, what is the relationship between the data in the existing information, what operations are required for solving the problem, what kind of storage structure can be applied and how is the storage structure combined with the data connection and required operations. Definition, how to design an algorithm for each operation, what classical algorithm ideas can be used, how to design program functions, what is the calling relationship between functions, what test data is designed, what is the data in the problem, how to define the storage structure, how to design the algorithm for each operation, what classic algorithm thoughts can be used, how to design the algorithm for each operation, what classic algorithm thoughts can be used, how to design the algorithm for each operation, what classic algorithm thoughts can be used, how to design the algorithm for each operation, what classic algorithm thoughts can be used, how to design the algorithm for each operation, what classic algorithm thoughts can be used, how to design dath ow about the data in the problem.

After the discussion of these experimental cases, the analysis processes will be written into a document in detail. During the teaching process, the students' typical practices and typical problems can be arranged according to the results of student discussions. These resources, including the original code of the program, are provided in the experimental instruction book to students to help them think and learn further.

One of the difficulties in data structure learning is the program implementation of each data structure. The pseudo codes used in the classroom teaching are not completely equivalent to programs, and program debugging also requires a relatively strong ability of program design and program debugging, so some students lost their patience. Complete program resources implemented in C or C + + will be provided in each experimental case. Students can analyse the program, imitate and write the program, and can supplement and modify it according to their needs or interests.

3.2 Seminar and Practice of Experimental Projects

The following teaching procedures are included.

3.2.1 Preparation Before Class (Minimum 2-3 Weeks)

Teachers will arrange experimental projects in advance to encourage students to think and guide them. Students can form groups of 2-3 people to select topics for experimental projects, analyse problems according to requirements and conduct research for the solutions to problems.

3.2.2 Seminar and Practice in Groups

Under the coordination of the group leader, each group member needs to cooperate with each other, access to information, have discussions, make queries and determine plans. All the procedures will train the students' ability to collaborate and actively explore and solve problems in discussions.

Students are required to follow the engineering ideas and steps, complete each procedure of problem analysis, design, program implementation and program testing, and complete their experimental reports.

3.2.3 Making Explanations on Stage and Demonstrating Programs

In order to encourage students to step onto the platform and express their own design plans boldly and clearly, and at the same time to prevent the phenomenon of free-riding among students, the group students will draw lots for one's turn to explain the experimental project through ppt. The problem, ideas for solving the problem, the designed data structure and main algorithms will be explained and demonstrated through the program.

3.2.4 Asking Questions and Conducting Debates

It mainly focuses on problems, ideas and algorithms for solving problems of the experimental projects. Any student can ask questions, even make doubts, or suggest improvements to the speaker's problem-solving ideas and procedures. The reporter can also explain, supplement and even refute.

Some open questions will also be raised in the experimental projects. Students can also discuss the problem-solving ideas during the question and debate procedure. They can also follow the engineering ideas and steps to analyse and solve problems. And finally, solve the actual problems making use of data structures and algorithm programs. Open questions allow students to think outside the box and their innovation abilities can be cultivated.

3.2.5 Making Summaries and Comments

The teacher will briefly evaluate the speaker's speech and the results of the classroom discussion, and supplement and expand the report according to the students' mastery of the report if it is necessary.

3.2.6 Seminar Evaluation

The teacher will evaluate the students' Seminar experimental discussion processes and experimental results and then give grades. The assessment content includes six parts: attendance, preparation, oral presentation, personal speech, group discussion, and experimental report. Attendance rate of 5% is used to check whether students are attending Seminar on time and preparation work, oral presentations, personal speeches, and group discussion accounts for 45%. It

mainly measures students' extracurricular preparation, class participation and contribution to group discussion, because the pre-class preparation and discussion process is the core content of Seminar; the experimental report generally accounts for 50% and the requirements are also high, so the students are given ample time to complete. It mainly evaluates the process of in-depth analysis and complete demonstration of the problems after discussion, and also the process of designing and debugging the program. After the seminar, the students will give unsigned scoring to the others. In order to improve the enthusiasm of mutual evaluation, the score accounts for 20% of the experimental results.

4. Construction of Experimental Teaching Resources

Since there are only 16 teaching hours of the experimental subject hours, three types of experimental resources are designed and arranged in the experimental teaching, including linear structure applications, tree and binary tree applications as well as graph applications. Each type of experimental resources, that is, the experimental teaching designs based on Seminar, is divided into two parts, classroom experimental cases and experimental projects, which are separately used for two experimental teaching sectors. In practical teaching, cases are selected according to the students' learning situation. When these experimental resources are provided to students, the experimental purposes, experimental contents and experimental requirements are explained in detail. At the same time, the students are encouraged to expand, supplement or even design experimental topics on their own to stimulate their awareness of participation and innovation.

The specific cases and project contents are shown in the table 1 below.

Subject	Classification	Content		Key Knowledge Points
The derivative of polynomial in one variable	experimental case	Use a linked list to represent a polynomial in one variable and find its derivative		Linear List, Polynomial arithmetic
Simple simulation of queues in banks	experimental case	To simulate the problem of bank queuin business windows	Queue	
Airline reservation systems	experimental project	To design a ticket booking system passengers to check routes, reserve ticker refunds	Queue, Linear List	
Simulation of business in a bank	experimental project	To estimate the average time a customer a bank using simulation methods offered driven simulation system for banking but	Queue, Linear List	
System simulation of queuing phenomenon	experimental project	To evaluate the business status of a bank through simulation methods		Queue, Linear List
Realization of Literary Research Assistant	experimental project	To count the occurrences and positions of certain adjectives in an English novel		String
Statistics of the tree species	experimental case	To count tree species according to data obtained Binary from satellites and sequentially output the Tree proportions of each tree specie		Binary Search Tree
WeChat moments	experimental case	To find out how many friends do the student with Set op the largest circle of friends has based on his friendship relationship		Set operation
Huffman coder / decoder	experimental project	To write a system of Huffman coding and Huffman Tree decoding.		Huffman Tree
Pasture repair	experimental project	To help a farmer determine the minimum amount H of money he can spend to create the N planks.		Huffman Tree
Subject	Classification	Content	Key Knowl	edge Points
Simulate the Doma Name Server of Intern using search algorithm tree structure	in experimental et project in	To implement a tree that reflects the structure of the domain name and is able to be used for searching for the domain name.	Tree	ž
The "Seven Bridges" issu in Königsberg	e experimental case	To judge whether a Euler circuit exists in a given graph	Graph, Con	nectivity

 Table 1 Experimental Cases and Experimental Projects

Six degrees	experimental case	To validate the six-degree space theory, that is, to determine the diameter of human relationship	Breadth-First Traversal
		networks.	
Roads to every village	experimental case	To construct roads access to every village with minimal investment	Minimum Spanning Tree
Tourism planning	experimental case	To seek for the most economical tourist route.	Dijkstra algorithm for single- source shortest path
The best selection for the	experimental	To make the total investment as	Kruscal algorithm or Prim
project of pipeline laying	project	small as possible by choosing the	algorithm for minimum
construction		best construction solution.	spanning tree
Selection for hospital	experimental	In what village should the hospital	Graph, Eccentricity algorithm
location	project	be built so that the distance is	
		acceptable to all villagers?	
"Importance" calculation	experimental	To calculate the compactness	Graph
of Nodes in Social	project	centrality of each node in an	_
Networks		undirected un-weighted graph with	
		different nodes.	
Exam for Harry Porter	experimental	In order to minimize the spell,	Graph, Shortest Path
	project	which animal whose image used to	Algorithm
		be the most difficult to shift should	
		Harry Potter take?	
Design and balance of	experimental	To reasonably allocate operating	Graph
assembly lines	project	units for the work place and	
		evaluate the efficiency of the	
		production line to achieve a	
		balanced production line.	
Open topic	experimental	To design one's own experimental	
	project	subjects and contents based on	
		what he has seen and what he has	
		thought in daily learning.	

5. Conclusion

The experimental teaching design based on Seminar was implemented in the experimental teaching of information management and information system specialty in our college, and we have achieved better teaching results. The inherent thinking mode of students, who accepted passively in the curriculum experiments of applications of data structure and algorithm, are changed and an open and free innovative learning environment is created, which enable the students to actively participate in experimental discussions, cultivate the students' innovative spirits and abilities, and improve their comprehensive skills and comprehensive qualities. Here are some concrete forms:

1) The students 'self-learning ability and research ability are enhanced and they are promoted to participate in discussions boldly. The students 'knowledge are expanded and their cooperation and innovation ability are also improved.

2) The system enables the students to thoroughly master the characteristics of logical structures for data structures and the characteristics of different storage structures in the experiment, and to choose the appropriate data structure according to a specific problem.

3) The system enables the students to learn to analyse problems, take advantage of classic algorithms, design better algorithms creatively and solve new problems.

4) The students' abilities to apply and practice are enhanced, and their abilities to analyse and solve problems are also improved.

5) The students' abilities to design complex programs are promoted and they have managed to preliminary grasp some engineering methods.

6) The students are allowed to take active experiments, independent experiments, cooperative experiments and creative experiments in the real needs of society. The students are allowed to release their innovative vitalities and intrinsic motivations, and their creativity and potential are stimulated for the cultivation of innovative talents.

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