Research on Innovation of Data Structure Experimental Teaching Based on Open Computer Laboratory

——Take Pu'er University as an example

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Abstract: This paper examines the current state of experimental teaching at Pu'er University's data structure course. In light of the existing issues, this paper proposes a method for fully utilizing the function of open computer laboratories to reform data structure experimental teaching, innovating the design of experimental content and process, developing an appropriate evaluation mechanism, and strengthening the educational function of professional practice courses. Thus, students' subjective initiative can be stimulated, as can their learning enthusiasm and ability to write programs to solve problems.

1. Introduction

Data structure is one of the required courses in the computer curriculum system for all computer majors in colleges and universities, and students of related majors must take data structure first, and Pu'er University is no exception. Its significance is reflected in various programming tests, and data structure is also required. [1]

Experimental teaching, as an important component of Data Structure Course Teaching, plays a unique role in integrating theoretical courses' professional knowledge. Students can learn to apply various structures and algorithms learned in this course to problem solving in a variety of fields by studying this course.

Due to the abstract concept and numerous algorithms of the course, approximately 80% of students believe that the course knowledge points are abstract and complex, the algorithm ideas are difficult to understand, and the programming practice is difficult [2]. How to achieve the best teaching quality under the constraints of students' poor learning foundations, limited teaching hours, difficult course teaching, and so on, while also improving and developing students' programming ability and computational thinking ability, deserves careful consideration by industry professionals [3].

This paper conducts innovative research on the method of data structure experimental teaching based on Open Computer Laboratory in order to realize the goal of data structure experimental teaching and cultivate students' practical ability and innovative ability at Pu'er University.

2. Functions of Open Computer Laboratory

After several years of construction, Pu'er University's various laboratories have fully met the needs of experimental teaching of various courses in the school. The function of the school's laboratories in serving local economic and social development has been well demonstrated with the establishment and improvement of the open laboratory system. Open computer laboratories in local colleges and universities are critical to the completion of experimental teaching and high-quality scientific research[4]. The author believes that the following are the most important functions of an Open Computer Laboratory.

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2.1. An important practice base for cultivating innovative talents

The goal of the Open Computer Laboratory is to develop highly skilled and sophisticated computer professionals. Experimental teaching is an important link in computer teaching because it cultivates students' engineering consciousness and practical spirit, their ability to solve practical problems on their own, their self-exploring learning ability, innovative spirit, and creative ability. The Open Laboratory has adequate experimental equipment, strong teachers, and a good practice environment, all of which contribute to the development of innovative talents[4]. Simultaneously, an Open Computer Laboratory can not only meet the individual needs of students, but it can also provide good practical experience to experimenters, making it an important practice base of experimental teaching.

Open laboratories exist not only to cultivate students, but also to provide powerful experimental resources and high-end equipment for university teaching and research personnel, which is an important guarantee for university researchers to improve their research ability and level.

2.2. Provide human resources guarantee for local social and economic development

Science and technology can be transformed into actual productivity through the construction of an Open Computer Laboratory. Information technology, for example, is being used to transform traditional industries and provide corresponding rectification plans for local economic development. Computer aided design and numerical control technology can be used to train modern information technology and applied talents for the local manufacturing industry through continuous research in the computer laboratory. On the other hand, an Open Computer Laboratory is an important location for public basic computer courses, as well as a practice base for improving college students' computer theory level and operation ability, particularly non-computer majors. Cooperate with universities, industries, enterprises, and institutions to hold and carry out various examination activities, training programs, academic conferences, and so on in order to realize technological progress, resource sharing, and cultural integration, promote regional economic development, and bring social and economic benefits to local communities.

The construction of the Pu 'er University Open Computer Laboratory has promoted the connection with the Pu 'er local economy and provided a guarantee of talents and resources for promoting the benign interaction between universities and local areas through two-way social service tasks with the society.

3. The "pain point" of data structure experimental teaching

Despite the fact that data structure is the most important basic required course for computer majors in all colleges and universities, the overall feeling from communication with colleagues is that it is difficult to teach, and feedback from students is that it is difficult to learn, and the overall actual teaching effect is not optimistic. In conjunction with the course's teaching practice, this paper examines the "pain points" of data structure experimental teaching, focusing on the following aspects.

3.1. Theoretical teaching is relatively boring, and students' interest in learning is not high

Since some older teachers are accustomed to traditional teaching methods and are unwilling to change, they are unwilling to invest the time necessary to learn how to use new media technology to assist teaching. They continue to teach from textbooks using the traditional classroom teaching method of "PPT+ dictation." The teacher explains the purpose, content, steps and precautions of the experiment, and even the debugging of the program, and then the students experiment and practice according to the teacher's explanation and requirements[5]. This completely disregards students' status as the main body, depriving them of their learning needs and ability to receive and digest knowledge. Students may have a sense of freshness at first, but after a while, their interest in learning gradually dwindles, their concentration in class listening and speaking drops, their homework becomes rote, and their teaching efficiency gradually declines.

3.2. Experimental teaching is disconnected from theoretical teaching

For teachers' sake, the college usually arranges for teachers with teaching experience or ability to take more professional courses, as well as basic programming courses (generally offering C programming courses) for some new teachers. After all, young teachers have only recently begun their careers, and their classroom experience is insufficient. Their understanding of the important and difficult points in teaching is lacking, as is their practical experience. Despite the fact that a course has been taught, the students' foundation is weak, the learning effect is poor, and the gains are modest. This directly leads to an inability to write correct program code during the data structure experiment process, which has an impact on the future development of experimental teaching.

In another case, due to the large number of classes that offer courses, it is common for the teachers of the basic course of programming and the course of data structure to be different people, resulting in a failure to establish a connection between the teaching contents of the courses before and after. Teachers in the basic course of program design are unaware of the knowledge required for the data structure course, and teachers in the data structure course are unaware of the program design-related content. Have teachers previously stated this? This may prompt the follow-up teachers to take some time to make up the lessons so that they can continue teaching.

3.3. The laboratory management mode is lagging

The laboratory is closed in the traditional laboratory management mode, which means that the administrator only opens and closes the laboratory door according to the use schedule, and the laboratory is closed when there is no experimental schedule. Although this protects the experimental equipment, it also keeps the students out of the door, and they can't use their spare time to conduct experimental inquiry, so the students' enthusiasm and initiative will suffer, let alone their ability to explore their creativity. Furthermore, some experimental managers are inept at or don't understand data structure experiments, so they can't provide effective guidance to help students learn and improve.

4. Innovation of Data Structure Experimental Teaching under Open Computer Laboratory

To address the issues of "difficult teaching" and "difficult learning" in experimental data structure teaching, we must improve the experimental environment, teaching methods, and innovative experimental schemes. When combined with our school's teaching practice, we believe it can be improved in the following areas.

4.1. Ensure the consistency between teachers of pre-courses and follow-up courses

In general, a basic programming course is offered prior to the start of a data structure experimental course to teach students the fundamental concepts and principles of programming and to develop students' practical programming skills. The fact is that improving the basic quality of program design is a "symptomatic remedy" for the difficulties of data structure experimental teaching. According to the previous analysis, when arranging the teachers of the basic course of programming, the college must also consider the arrangement of the follow-up data structure course, or when arranging the experimental teachers of data structure, it is necessary to arrange the teachers who have completed the teaching of the basic course of programming in advance. As a result, the course responsible teacher will have a better understanding of what knowledge the basic programming course should help students learn. What skills are developed? We can avoid repeating some basic programming knowledge and spend more time on experimental teaching when conducting data structure experimental teaching.

To put it another way, dealing with the transition from program design to algorithm design is critical in the process of data structure experimental teaching in order to overcome the difficulties of data structure experimental teaching.[6]

4.2. Give full play to the function of Open Computer Laboratory to stimulate students' enthusiasm and creativity in experiments

Maslow is the primary founder of humanistic psychology, and he believes that "learning cannot come from without, but must come from within." Teachers cannot force students to study, and students should choose and decide on their own learning activities.[7] "After Pu'er University built the Open Computer Laboratory, the laboratory's management system became more perfect and humanized." The laboratory administrators have been greatly enriched, and the laboratory is now open at all times, so that students can conduct experimental inquiry at any time and find the pleasure of learning in the experiment.

Of course, in order to fully utilize the function of the Open Computer Laboratory, teachers must be "open" when organizing the experimental contents. That is, the experimental project's design should be adaptable and not limited to the arrangement of textbooks or teachers. Although the teacher planned experiment A, it is not necessary to complete it before the experiment is completed. Students can complete experiment B with equal or greater difficulty. Teachers only need to evaluate the results based on the difficulty and completion of the experiment and record them as experiment A results. Students with a solid foundation can then explore more challenging problems based on their own interests, rather than wasting time on too simple experimental tasks, allowing them to get more difficult exercises and keep their creativity stimulated.

4.3. Make full use of the Internet to innovate experimental teaching

Depending on the subject's characteristics, some backward confirmatory experiments are deleted, valuable confirmatory and skill-based experiments are retained, exploratory experiments are greatly expanded, or original confirmatory experiments are changed into exploratory experiments.[5]

Nowadays, the Internet is an essential tool for learning, as well as a vast knowledge base. In the actual teaching, an online course of data structure experiment is built using the MOOC platform, and experimental teaching videos related to theoretical teaching, as well as some simple verification and skill-based experiments, are published to the online course, so that students can log on to the platform at any time to watch and learn, as well as explore and complete related experiments on their own. At the moment, an increasing number of professional experimental practice platforms have emerged, for example, the first song (EduCoder) practice teaching platform, and students can log in to the first song (EduCoder) practice teaching platform in their spare time on Open Computer Laboratory machines connected to the Internet to conduct experiments on their own. There are also some comprehensive or designed experiments on the platform, and teachers can assign a certain number of such experiments to their students. Furthermore, in order to truly develop students' potential and improve their research ability and level, it is necessary to encourage them to conduct more such experiments through incentive measures such as extra points. With the widespread adoption of virtual reality technology, there will be an increasing number of online virtual laboratories, and students' ability to learn via the network will be greatly expanded.

The future research direction will be to fully utilize the Internet for data structure experimental teaching and practice.

4.4. Innovative experimental teaching evaluation mechanism

With the reform of the teaching mode and teaching method, a new teaching evaluation mechanism must be developed. A scheme of data structure experimental course performance evaluation from many perspectives was developed in order to stimulate students' independent research ability at Pu'er University. The usual grades account for 40%, the final examination results for 30%, and the ability assessment for 30%. Typically, the results focus on the assessment of students' online learning and the completion of confirmatory and skill-based experiments; ability assessment focuses on students' completion of comprehensive experiments offline or through an online experimental platform, particularly those who can complete innovative and difficult experiments, and this achievement must fully reflect this achievement.

5. Conclusion

According to physicist Yang Zhenning, American teaching methods emphasize induction, analysis, infiltration, and synthesis, which is an "experiential" teaching method whose effect is independent thinking and creative ability.[8]

Colleges and universities have an unassailable responsibility to educate people for the country and the party. With the increasing popularity of the Internet, the development and application of new technologies such as artificial intelligence and virtual reality will undoubtedly encourage the continuous innovation of teaching modes and methods. We must innovate teaching ideas and methods as data structure experiment course teachers, develop a more effective "experiential" experimental teaching mode, fully utilize the function of Open Computer Laboratory, and cultivate more high-quality talents with the ability to discover, analyze, and solve problems.

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