



Exploration of Innovative Teaching of “Computer System Architecture”

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Abstract. Because the traditional teaching mode and experimental examination are not very reasonable, students’ enthusiasm and initiative in learning are not high, so the teaching effect is not ideal. In this paper, the experimental teaching of computer system structure is reformed from the aspects of open and innovative experimental teaching mode, reform of the examination way of experimental courses and open laboratory platform with experimental teaching. Working principle of the computer components and fusion technology in experiment teaching content, make the theoretical teaching and experimental teaching depth fusion, gradually train students to use theory of curriculum knowledge design related experiment ability, improve students understand and master computer hardware theory knowledge and apply knowledge to solve the problems of the comprehensive experimental design ability, improve students use the knowledge The ability of understanding and solving complex engineering problems is helpful to achieve the teaching objectives of the course. At the same time, it has increased students’ interest in learning, improved their practical ability and innovative thinking, and achieved good experimental teaching effect and results.

Keywords: Experimental teaching · Computer system architecture · Innovative experiment

1 Introduction

Computer System Architecture Experiment is to study and analyze the structure and performance of computer systems from the overall, system level, under the condition that students have an understanding of the current development of computer system architecture, to help students understand the concept of computer systems, so that students can master the basic concepts, basic principles, basic structure and basic design methods of computer system architecture, to lay the foundation for learning subsequent courses. At the same time, reforming the assessment method of innovative experimental results, changing students’ learning concepts and attitudes, improving their learning enthusiasm and initiative; exercising students’ practical operation ability and hands-on ability, improving their creative thinking ability; cultivating students’ scientific way of thinking, scientific attitude of seeking truth from facts, rigorous working style and spirit of exploration and research. Experimental teaching is an important part of teaching in

science and technology colleges and universities, and it is an important link to achieve the goals of quality education and training of innovative talents [1].

Experimental performance assessment is a teaching assessment method that is appropriate to certain experimental teaching objectives, and plays the role of "baton" in experimental teaching, which is a key factor affecting experimental teaching. Due to the deep-rooted traditional education concept, the current experimental teaching overemphasizes the guiding role of theory, while experimental teaching is only regarded as a verification and accessory of theoretical courses, as a reference to the examination results of theoretical courses, in the status of "optional" [2, 3]. The traditional experimental teaching ignores the law of its own development, ignores the role of experiments to complement, deepen and develop the theory, which leads students to do experiments "by the book, according to the prescription", not only do not pay attention to the experiments, but also do not pay attention to the experimental results [4]. In terms of the current experimental performance assessment method, the main basis for the assessment is the experimental report, which leads to the generation of many lazy students and makes it difficult to achieve the purpose of quality education and training of innovative talents.

Computer System Architecture is a discipline that focuses on the external characteristics of computer systems to study the structure of computer systems, and is a professional and technical foundation course for computer and related disciplines [5]. The course emphasizes the cultivation of abstract thinking ability, top-down system analysis ability and innovative design ability of computer science students, which is basically offered in major and general universities nationwide and has produced a large number of teaching and research results. It is necessary for the students of this major to learn and apply the knowledge of computer system architecture well. Therefore, in order to make students learn better and teachers teach better, the original experimental system of computer system architecture must be reformed.

2 Transformation of Experimental Teaching Concept

The theoretical teaching of computer system architecture course is relatively abstract and needs to be combined with experimental teaching in order to make students understand the structure and performance of computer system, cultivate students' research ability and practical ability, and improve students' comprehensive ability. In terms of the effectiveness of the current experimental teaching, it is necessary to explore and reform the experimental teaching concept to solve many problems in experimental teaching, such as insufficient experimental class time, single and old experimental projects, and failure to closely integrate experimental teaching with theoretical teaching [6]. In view of this, this paper proposes to establish an open and innovative experimental teaching system, as shown in Fig. 1.

For the previous experimental class, students learn the experimental project only in the "single verification, get the predicted results can be" level, students just to complete the task and do the experiment, the teaching effect is not obvious. The concept of experimental teaching is changed from "teaching by hand and transparently" to "step by step", in accordance with "strengthen the foundation, broaden the In accordance with the policy of "strengthen the foundation, broaden the profession, focus on practice, improve

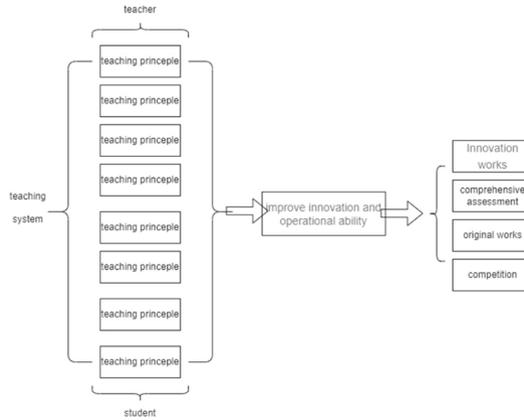


Fig. 1. Experimental teaching system.

the quality" to build a multi-level experimental teaching system of "verification - design - synthesis - innovation", teacher-led, student-led, strengthen the interaction between teachers and students, and establish a multi-level experimental teaching system. The system of multi-level experimental teaching is established with the teacher as the leader and the students as the main body, and the interaction between teachers and students is strengthened.

In order to adapt to the new structure of the experimental teaching system and the need to cultivate high-quality talents, it is necessary to improve the teachers' own experimental teaching level [7]. In the process of experimental teaching, teachers should not only have broad professional knowledge, but also have strong teaching ability, innovation ability and research ability, so that they can guide students to exercise innovative thinking and research ability. At the same time, students should abandon the idea of "completing the task by following the specified experimental instructions, using the specified equipment, following the specified experimental methods and operation steps, and measuring the basic correct data", and actively study the experiments, thinking more, asking more questions, and interacting more to stimulate learning enthusiasm and promote thinking ability.

In the arrangement of experimental classes, on the basis of gradual and reasonable arrangement of experimental teaching process and content, attention is paid to the organic integration with theoretical classes and the contents are connected with each other [8]. The experimental assessment incorporates several aspects such as experimental attitude, experimental ability performance and experimental results, which are involved in the calculation of experimental assessment scores. At the same time, the experimental assessment system of basic experiments, research experiments and final comprehensive experiments is opened, which requires students to grasp the key operations on the basis of mastering basic theories and basic operational skills, and to design experimental programs by integrating the knowledge, skills and methods of multiple disciplines, so that students can fully use the knowledge they have to identify problems, analyze them and

solve them, thus improving their innovative The students will be able to use their knowledge to identify, analyze and solve problems, thus improving their creative awareness and innovative thinking ability.

3 Open Labs in Conjunction with Research

With the continuous reform of the university education system, experiments are gradually changing from the subsidiary status of theory to an independent teaching system, which has become an important part of cultivating students' innovative thinking and ability [9]. Cognitive experiment course can not be dispensable, in the introduction of new experimental equipment and advanced experimental software at the same time, to attach a hierarchical experimental instructions; Encourage teachers with scientific research ability and project experience to come into the laboratory and selectively design comprehensive experiments by combining scientific research projects with experimental projects; Open laboratory, provide open experimental environment, so that students can better, make full use of laboratory space and time.

Scientific research and teaching of higher education is an integral whole [10], at the same time of teaching, scientific research ability of the teachers can put the part of introduction of experimental teaching, the scientific research project on the one hand allows students to complete the experiment research pattern, the content of the course can not only increase students' interest in experiment, and can improve the students' practical ability and comprehensive ability to solve problems, Then improve students' innovation consciousness and ability; On the other hand, the scientific research achievements can be timely transformed into practical teaching, which not only enriches the experimental teaching content, but also promotes the improvement of teachers' level and teaching quality, thus forming a virtuous circle of promoting learning by teaching, promoting teaching by learning, benefiting from teaching and common development.

First of all, update the idea and content of experimental teaching, design experimental projects around three levels, try out stratified experimental teaching, establish three levels of experimental projects: verification of cognitive, comprehensive design, research innovation experiment. Strengthen the proportion of comprehensive design and innovative research experiments. Actively advocate students' independent design, independent arrangement, research and innovative experiments. It emphasizes scientific research to promote teaching, integrates cutting-edge scientific knowledge and the latest research achievements into practical teaching, and allows students to directly participate in scientific research projects or engineering projects.

Secondly, in the method and means, the use of advanced computer technology, improve and develop the experimental courseware, the experiment moved to the platform, has improved the analog circuit, digital circuit, computer composition principle and other experimental courseware, developed the computer system structure, function generator, and other experimental courseware.

4 Reform the Assessment of Experimental Performance

In order to supervise and urge students to learn, to cultivate students diligent, rigorous style of study and learning attitude, the inspection is to examine the effects of teaching

means, experiment result is a standard for students experimental ability evaluation, but only with the experiment result to show that the students master the comprehensive level of the course, there exist certain disadvantages, therefore, in order to achieve the purpose of assessment of students' comprehensive quality, In order to evaluate students' learning effect, we must reform the present examination method of experimental class.

Experimental results are the objective reflection of students' practical ability, operational skills and problem-solving ability in the experimental process, and the evaluation of students' comprehensive ability in the experimental process. In order to reform the examination method of experimental teaching, we should pay attention to students' learning attitude, experiment process and practical effect, and reform the contents, methods and means of the examination of experimental results. In view of the particularity of students, the examination methods are reformed and innovated actively from many aspects such as ordinary scores and final exam scores, and the corresponding examination and evaluation standards are formulated. By reforming the examination method of experimental course results, correct students' attitude towards learning experimental course and increase their enthusiasm and initiative in learning; Improve students' understanding of experiment content, enhance students' practical ability; At the same time, teachers can accurately grasp the students' grasp of the content of the experiment.

The evaluation of experimental results should include all aspects of the experimental process into the assessment elements, and take the way of scoring on the experimental site. By observing the experimental process of students on site, we can understand their experimental attitude and practical ability. Through the interaction of teachers and students to ask questions, to understand the students' grasp of experimental theory and content; Through the analysis of experimental data and examination of experimental reports, to understand the method and ability of students to deal with problems on site; Timely feedback of the assessment results, help students timely correct the problems and deficiencies in the process of experiment. The experimental results can basically reflect the real level of students' comprehensive experimental ability and ensure the objective and fair experimental results to the maximum extent.

In this paper, the specific methods of experimental class performance assessment are as follows:

First of all, the school educational administration department under the State Council about "student experiment result standardized assessment methods" guidance document, designed to strengthen the experiment teaching of middle school students' actual operation ability, the experiment teaching into the school educational administration department standardization and quantitative management category, the file should include the attendance, experimental theory and experiment operation, experiment report and experiment examination.

Secondly, the evaluation of experimental results should combine the basic experimental results, research experimental results and final results, and jointly participate in the calculation of the final experimental results. The assessment of basic experimental results is divided into three parts: preview, operation and report. The examination of the experimental preview stage is mainly carried out before entering the experimental operation. In addition to writing detailed experimental preview reports, students are familiar with the use of various instruments and matters needing attention, and they can draw

experimental design drawings according to the experimental content, and also answer the teachers' questions on the preview thinking questions. In the experimental operation stage, the assessment is mainly carried out in groups of classes, with each group completing the experiment independently and correctly, and teachers visiting and coaching and checking data records. The evaluation of the experimental report stage is mainly carried out after the operation, including whether the experimental report is written seriously, whether the description of the experimental principle is concise, whether the data collection and processing are correct and reasonable, and whether the analysis of experimental errors is clear. In the basic experiment process, if any student can put forward the improvement idea or carry out the extension experiment, we will give corresponding bonus points, so as to encourage students to actively study, positive thinking, positive innovation.

The open experimental teaching of research experiment requires students to complete a research experiment in their spare time in this semester, which mainly investigates the background, purpose and research significance of the experimental subject, experimental principles and methods, innovative points, and analysis and discussion of experimental results. Submit the final experimental scientific and technological achievements, independently write the research experimental report in the form of scientific and technological papers, encourage them to summarize and publish the results in the form of papers. Open, flexible and diversified research experiments leave broad space for students to think, students can think creatively, free play.

The final examination is generally carried out after the end of the whole experimental teaching course. The propositions of the experimental examination should cover all the knowledge taught in this semester, including basic theoretical knowledge, but also involve relatively comprehensive and difficult problems, so as to conduct a comprehensive assessment of the knowledge of the course. Finally, the most appropriate and practical experimental results are given by combining the basic experimental results, research experimental results and final results.

5 Conclusion

The practical application of the open and innovative experimental teaching system in this course has not only enabled students to understand the basic knowledge of computer system architecture and master the basic performance analysis of the system, but also improved their ability to analyze and solve problems and cultivated their innovative thinking skills. While teaching this course according to the curriculum, some students are not satisfied with simply learning the knowledge of this course according to the experimental arrangement, but also take the initiative to ask questions, seek and explore challenging experimental projects. We have built an innovative experimental platform for students to learn better and use the flexibility of the field-programmable software to guide students to actively carry out scientific and innovative design activities, which will not only improve students' practical hands-on skills, but also improve teachers' innovative research.

The course has been reformed and received good results in practical applications. The author has written and published two textbooks, "FPGA-based Computer Architecture Practice Course" [11] and "Quartus II-based Computer Composition and Architecture Comprehensive Experimental Course" [12] which have won many provincial and university-level awards.

We have one patent authorization, more than 20 software publications, more than 20 academic papers, and 7 research projects for students and teachers. Through the exploration and practice of open and innovative experimental teaching mode, we have achieved certain teaching results. The development of the information discipline has constantly put forward new requirements for the current experimental teaching system, and how to cultivate high-quality students with strong hands-on ability and innovative spirit in experimental teaching is not only the main goal of experimental teaching reform, but also the subject of our continuous exploration and practice. Therefore, according to the policy of "strengthen the foundation, broaden the specialty, focus on practice and improve the quality", the construction of "verification—design-integration-innovation" is a multi-level experimental teaching system. The multi-level experimental teaching system is of great significance to the improvement of teaching level and the cultivation of high quality talents with strong ability.

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