

## **Exploration and Practice of Building Experiment Teaching Architecture of “Two levels, Three Steps and One Technology Roadmap” for Computer Hardware Series with Engineering Characteristics**

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**Abstract.** Based on the Construction of National Computer Experiment Teaching Demonstration Center, this paper focused on some problems existing in the experiment teaching for computer hardware series, built experiment teaching architecture for computer hardware series of "Two levels, Three Steps and One Technology Roadmap" with engineering characteristics, updated the idea of experiment teaching and improved experiment teaching method and means, established a wide range of experiment teaching system. Practice shows that the experiment teaching system and mechanism could greatly improve the students' practice and innovation abilities.

### **Introduction**

Under the background of New Engineering, it is very important to improve the students' engineering practice ability in improving the talent training quality of Colleges and universities. [1]. In recent years, the domestic universities have strengthened practice teaching reform, optimized experiment curriculum system, optimized experiment teaching resources, and actively promoted the research-based teaching, to improve students' ability of practice and innovation [2].

### **Problems in Computer Experiment Teaching for Hardware Series**

We surveyed engineering education modes and experiment teaching systems of many universities with the different levels, especially in engineering colleges and universities, including Tsinghua University, Fudan University etc. The universities have their own characteristics in their management styles and discipline advantages. These different experiment teaching systems and engineering education modes are of great reference significance [3].

As one of National Experiment Teaching Demonstration Centers in the computer discipline, Our Computer Experiment Teaching Demonstration Center has made some achievements, but like many domestic colleges and universities, there are still many problems.

### **Undergraduates' engineering ability needs to improve**

Undergraduates' social acceptance is the main index for measuring the effectiveness of teaching as the university's "products". What the market needs is inter-disciplinary talents who have solid theories, the ability to analyze and solve problems, and the ability to take the initiative to acquire knowledge. However, the facts are very different. For example, during professional engineering certification of Ministry of Education in computer science and technology, it was clearly pointed out that engineering practice ability of undergraduates is weak, especially the application ability of computer hardware needs to be further increased in our university in 2010.

### **The experiment teaching of computer hardware has not been regarded seriously**

Computer hardware design and application has been a feature of computer science in our university since 1958. However, with the development of computer technology, computer hardware experiment teaching in our university has declined, the computer science and technology has insufficiency in the field of computer hardware. At present, the amount of teachers who could have class and instruct experiments in computer hardware is small. Many hardware experiments, such as Microcomputer Principle and interface Technology, Computer Architecture, etc., are at a low level.

### **The experiments are stale, and the method for experiment evaluation is single**

With the development of computer science, computer engineering experiment has changed from traditional single computer experiment to system experiment and network experiment [4]. However, the computer hardware experiment in our university has not only many monotonous and obsolete content, but also lack of experiment teachers. Also, verification is still main way to assess in computer experiment teaching.

## **Consideration of the Current Situation of Computer Experiment Teaching**

### **How to integrate the experiments' content of computer hardware related courses**

In order to link the courses, it is possible to integrate the teachers of these courses as a team. The computer hardware courses have their own features, and there are many relations between the courses, so one of the important ways to integrate these courses is to develop comprehensive experiment platform which could construct connections among these courses including Assembly Language Programming, Microcomputer Principle and Interface Technology, and so on.

### **How to improve undergraduates' ability of engineering innovation**

Innovative experiment teaching could improve undergraduates' engineering application ability. The innovative experiment is beyond the experiment syllabus, including: taking part in the National Undergraduate Electronic Contest, participating in the research projects of the teachers. It is supposed that experiment environment including hardware and software such as excellent advanced equipments and tools, technical guidance, should be provided. Support actively the students to participate in various scientific activities and scientific research of faculties. Take advantage of these scientific projects to extend the experiments' content, use the theoretic knowledge and experiment skills to research. The research results and practical experience were used in experiment teaching, which could further improve the quality and level of innovative experiment teaching.

### **How to assess experiment teaching reasonably**

It is necessary to build scientific and reasonable experiment assessment methods to evaluate the undergraduates' experiment design. The use of a variety of experiment evaluation system, such as putting the competition works, innovative projects and other works into the scope of the experiment assessment, could greatly improve students' interests in learning.

## **Ideas and Measures to Solve the Problems**

### **Building Experiment Teaching Architecture of “Two levels, Three Steps and One Technology Roadmap” for Computer Hardware Series**

There is a certain relationship between required courses and elective courses of computer hardware series. Through these courses students should be able to gradually establish the concept of the entire computer system design, master the design techniques of the computer system, and master control application of computer. Using the viewpoint of development, we followed the knowledge structure of computer specialty, and constituted experiment teaching system of “Two levels, Three Steps and One Technology Roadmap” with experiment modules of each hardware course,

experiment modules between whose hardware courses there is the logical relation, engineering training modules of functional combination, the innovative and advanced comprehensive practice modules. As shown in Fig.1.

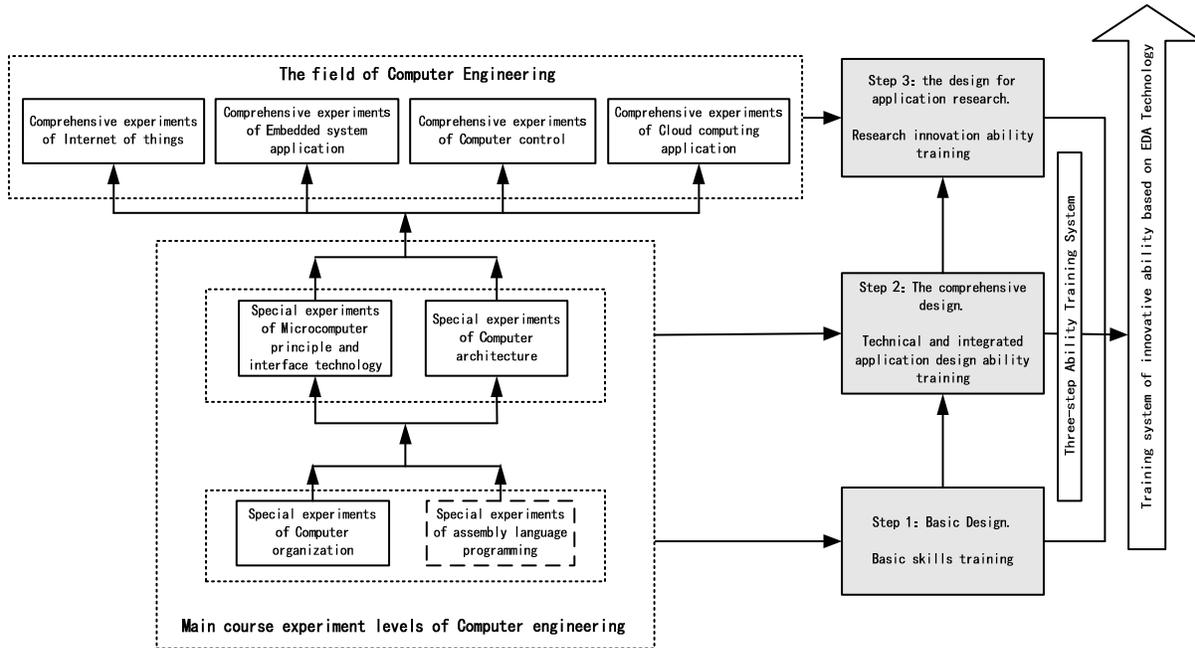


Figure 1. Experiment Teaching System for Computer Hardware Series.

The first level of the two-level experiment teaching system is the main course experiment of computer engineering, the second level above the first level is the field of computer engineering. In the first level, the main hardware related courses of undergraduate include “Computer organization” and “Computer architecture”. Major courses related required courses for undergraduate include “Assembly language programming” and “Microcomputer principle and interface technology”. These courses, especially the main courses, are not only more sequential, but also have strong relevance. Fig.1 shows the experiment hierarchy of the main course for computer hardware series. Among them, the dashed box section is an experiment of partial software type.

The basic design project in Three-step Ability Training System mainly emphasizes the fundamentality of experiment, and focus on basic training for a single course experiment or a single instrument set to aim at basic skills undergraduates must master. The comprehensive design project is comprehensive and designing experiments that take the basic course content as the main part, and enable students to use knowledge synthetically in the course of experiment. On the basis of widening the experimental content, the design for application research increased research section reflecting practical problems, and combined with production and scientific research to further broaden the students' thinking and innovation space. Experiment teaching from the foundation to the application, and then to innovation, step by step, strengthened the whole process of hierarchical training for the undergraduates from micro to macro, from skills training to comprehensive ability training, and from exploration practice to innovation ability.

### Reforming Experiment Teaching Methods

The experiment teaching of computer hardware series is divided into four levels: comprehensive experiment teaching, designing experiment teaching, research-based experiment teaching and innovative experiment teaching. There are different teaching methods at different levels:

Comprehensive experiments could further integrate experiment content of computer hardware courses based on single subject experiment, establish a unified platform, accomplish integrated application of multi-subject, and implement more complex design of computer hardware system, in order to achieve full integration for the entire computer hardware knowledge.

As an important part of innovative experiment teaching content, the designing experiments need many guarantees, such as guidance and inspiration from a high level of teachers, arranging abundant and flexible experiment class hours, providing content-rich and selectable design topics, configuring complete instruments and experiment materials, establishing a reasonable scientific experiment evaluation standard.

The research-oriented experiment teaching requires students to take the initiative to consult the relevant literature and information. Also, the teachers should guide the students to accomplish the experiments, and to discuss and to analyze experiment results, and organize the students to carry out the communication of new technology, new method and new method of experiments, and strengthen students' ability to observe, analyze, identify and describe scientifically, and continuously improve students' ability and level for scientific research, finally, train students to participate in scientific research and production practice in advance.

Innovative experiments have gone beyond the scope of the experiment teaching syllabus. Innovative experiment teaching could provide experimental environment, and actively support the students to participate in various technological activities, and support students to participate in the facilities' research projects, and extend experiment content with the support of these projects.

### **Training Students' Engineering Innovation Ability**

In the construction of innovative students training system, students' innovative activities were carried out relying on Undergraduate Innovation and Entrepreneurship Centers, and Competition Centers to train students' engineering practice ability.

### **Developing Comprehensive Platform for Computer Hardware Experiments**

Integrated experiment development platform was researched and developed to integrate the main courses of Computer Engineering together with the comprehensive experiments in the four fields of Internet of Things Engineering, Embedded Systems Applications, Computer Control and Cloud Computing.

### **Summary**

With the National Computer Experiment Teaching Demonstration Center, this paper tried to explore and practice in the practice teaching, and constructed experiment teaching architecture of “Two levels, Three Steps and One Technology Roadmap” for Computer Hardware Series with Engineering Characteristics. Practice has proved that the new experiment teaching architecture greatly improved the students' practice ability and innovation ability.

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