Exploration and Reform of the Practical Teaching Mode of Computer Composition Principle Experiment under the Target of Applied Talents Training

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Abstract. The aim and requirement of cultivating application-oriented talents are persisted through the whole practice teaching reform, this paper explores the reform idea of computer composition principle experiment teaching from the perspective of training application ability. This paper expounding the integrated hardware curriculum planning; mobilizing the students' subjective initiative fully, translate into "students mainly, teachers are auxiliary"; reforming the content of the experiment, and increasing the proportion of design and comprehensive experiment rationally; introducing research, innovative projects and open experiments; The experiment teaching mode of computer composition principle is reformed and explored.

Introduction

In 2016, Ministry of Education made a clear proposal to guide the transformation of a number of undergraduate colleges and universities into applied technology colleges and universities. In that year, the state council issued the decision on speeding up the development of modern career education, and fully deployed the development of modern career education[1]. The decision clarifies the guiding ideology, basic principles, target tasks and policy measures to accelerate the development of the modern career education on the next period, by 2020, it will be possible to meet the needs of development, the integration of production and education, the cohesion of vocational and vocational colleges, and the communication between education and ordinary education, embody the idea of education for life, form a modern career education system with Chinese characteristics and world level[2].

Huaihua University as a local university, school leadership according to the requirements of the state council and the ministry of education, combining with our school characteristic, proposed to build Huaihua University as the target of local and high level applied undergraduate university. The talent cultivation of computer science majors is characterized by high applicability. Course of computer constitute principle is the basis core courses of computer classes professional, it plays a structure connecting ecosystem and individuals, software and hardware in the computer class specialized compatible important role, is a course of the more important, it plays an important role in computer science, software and hardware compatibility, it is an important course[3]. The principle and system composition of computer operation are embodied in this course, which is both abstract and strong practicality. Therefore, it is of great practical significance to explore how to reform the curriculum of computer composition principle experiment based on the target of applied talents training.

This paper analyzes the current teaching contents, methods and platforms of computer composition principle experiment firstly, and then it puts forward some exploration and improvement by combination with the application requirements and current teaching methods.
Current Situation of Practice Teaching and Mainly Problems

In order to improve the practice ability, most universities have special computer composition principle experiment course now, but on the whole, the practice teaching has not got rid of the traditional teaching mode, and the teaching effect is far from the requirement of the applied talents training which practical ability and innovative ability.

Currently there are several ways to set up a computer composition theory experiment in universities: One is to use the most primitive hardware experiment platform, the experimental box has already solidified the calculation device, memory, controller, program computer and so on, students follow the instruction to insert the attachment and verify the result of the experiment. In this way, students lack the initiative to think, the purpose of understanding the content and practical application is not achieved[4]. The other is a system simulation platform based on pure software, which is designed and verified by software simulation platform, the advantage of this approach is that the cost is low, the disadvantage is that the students have not really experienced the close integration of the computer and the hardware, and finally the student interest is gradually lost. The Third is using the EDA (electronic automation) design method, the experimental box mainly USES FPGA (field programmable array) as the main CPU, and coordinates corresponding input, output and display modules, using the VHDL language (hardware description language) to design the module device, then the FPGA can be used for experimental verification. The advantages of this hardware platform are flexible and can be designed according to the design requirements, achieve the ultimate goal of training objectives with applicability, but this is a high requirement for students.

Our hospital using the experiment box of computer composition principle experiment is produced by Hangzhou Kangxin electronics co., LTD, which the main CPU is the Cyclone series FPGA chip. the main CPU of experiment box based on FPGA chip is the mainstream of computer composition principle, this allows the hardware description language to be designed and verified on FPGA, the basic conditions for students to carry out innovative and applied experiments can be met. At present, the main contents of computer composition principle experiment of our hospital are shown in Table 1.

Table 1. Experiment contents.

<table>
<thead>
<tr>
<th>The name of experimental project</th>
<th>Design level</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight adders</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Arithmetic logic unit</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Shift arithmetic unit</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Memory (RAM, ROM)</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Program counter</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Address register</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Pulse generator</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Microcontroller</td>
<td>Component level</td>
<td>Verification</td>
</tr>
<tr>
<td>Basic model machine design</td>
<td>CPU design</td>
<td>Comprehensive</td>
</tr>
</tbody>
</table>

According to the communication with the neighboring school teachers, the computer composition principle course seminar and other forms of information, at present, the content of computer composition principle experiment of most universities in China is basically similar to that in table 1. And it is the verification experiment basically.

On May 5, 2017, a new practical teaching method seminars about computer hardware course held in Suzhou University, we have discussed the popularity of software development technologies based on J2EE, Android, IOS, and H5. These technologies are easy to use, low entry barriers and quick results, so it is a common phenomenon that students of computer majors in universities have “play the bully”, that is students and course schedules are all paying attention to software courses, but ignoring
hardware courses. This will lead to the hardware continues to rely on foreign chip manufacturers in the artificial intelligence era on our country, make our country will lose the opportunity of hardware development, and get rid of the foreign technology, let our country miss the opportunity that has the real chip design, manufacturing technology.

Nowadays, there is a common phenomenon that have “play the bully” in universities, there are many reasons to pay more attention to the application development and neglect of the underlying hardware. the follow are several reasons.

(1) The myth of the top-level design planning personnel training plan, personnel training plans are for the purpose of applied talents training, and the most easy to reflect the direction of the application, and within the effective is the upper software application development direction. In many schools, computer composition principle courses are offered for postgraduate purposes only, this course is considered to be optional, after all, it is not important to contact the upper application development with the computer system principle.

(2) The problem of the experiment content. At present, due to the lack of previous guidance courses such as VHDL language and digital logic, so the content of computer composition principle experimental course is mainly based on the verification experiment, students conduct the experiment according to the experimental instructions basically, the experimental principle and experimental design process are seldom considered, just to get the credits, so unable to meet the teaching objectives of experimental curriculum to improve students' hands-on ability, unable to give full play to students' active thinking ability and innovative thinking ability, it is impossible to truly understand and master the principles of computer systems for students.

(3) The results of the experiment were not obvious. The theory of computer composition principle is complex, abstract and difficult to understand, and the students generally reflect boring and uninteresting. The experiment course is to change abstract content into concrete image, to improve students' learning interest and enthusiasm. However, the verification experiments are all downloaded to the FPGA module for simulation, and the simulation results are correct for the end of the experiment. The design is not produced in kind with the form of physical chips, so that the experimental results are not vivid enough.

(4) The examination standard cannot reflect the learning difference. The computer composition principle experiment course is open book examination class basically, the examination results are based on the results of the experiment, the class situation and the submission of the experimental report. The results of verification experimental are basically the same, and the experiment report is the same, almost all students can complete, cannot reflect the differences between students, there would be no push up some outstanding student's enthusiasm and creativity.

(5) The shortage of relevant talents such as experimental teachers and full-time laboratory managers. The lack of talents also makes it impossible to update the technology in time, and cannot actively lead to innovative experiments.

(6) The laboratory opening is not enough. Due to the management and maintenance of experimental equipment, the open laboratory of most schools is mainly on the surface. Even though the laboratory provides equipment, it lacks the effective support for open-ended research and the guidance of teachers, which leads to the unsatisfactory effect.

**The Goal of the Applied Talents Training**

Society and universities are calling for the applied talents training. What kind of the talents is the applied talents? The applied talents are applying the mature technology and theory to the actual production and daily life, applied talents training is mainly to transform the research achievements into practical application. They need to master the basic theoretical knowledge, participate in necessary scientific research, face the front line of social production, and train qualified personnel according to the actual urgent needs of the society. So how do we have effective training for applied talents? The cultivation of application-oriented talents should pay attention to the following points:
firstly, the ideological mode of academic and research should be broken in the teaching mode, and the research and application should be combined. In the course system, the combination of theory and practice, inheritance and innovation. In teaching methods, students should be strengthened as the main body of teaching activities, and make full use of traditional and advanced technologies in teaching methods. In the training way, we will strengthen cooperation between schools and enterprises, connection between schools and local government, realize the organic combination of industry, study and research[5-6].

Aiming at the requirements of the applied talents training in computer composition principle experimental courses, the requirements of computer constitute principle Experimental course is through the experiment to master the five parts of the basic structure that computer hardware arithmetic unit, controller, memory, input devices and output devices, and working principle of the whole system. The corresponding basic modules and the whole machine should be designed and applied according to the knowledge and practical application requirements. This is the ultimate goal of the applied talents training.

**Exploration and Reform of Practical Teaching**

The computer composition principle course plays an important role. On the one hand, it need to use the knowledge of digital logic, VHDL language and other aspects. On the other hand, it need to lay the foundation for the computer system in the back. In view of the current problems existing in the experimental teaching of computer constitute principle, combined with the requirements of the applied talents training in university, in order to achieve the training goal of the teaching of the composition principle, this paper will carry out reform and exploration of the teaching mode from the following aspects.

(1) Integrate curriculum group planning. Effective development of computer constitute principle experimental courses need a good group, which the leading course include digital logic circuits, analog circuits, assembly language, VHDL hardware description language, Verilog, and subsequent courses. Since a lot of computer majors are not required to master hardware description languages such as VHDL and Verilog in many school, however, in order to further develop students' application ability through the computer composition principle experiment course, the corresponding hardware description language must be used to design the modules, devices and so on. So in order to strengthen the cultivation of students’ ability to design, can separate of theory and experiment of computer constitute principle, the experiment separately listed as a compulsory subject, implement small class teaching, at the same time ensure that every student has a test chamber device, provide good condition for teaching researches.

(2) Play students' subjective initiative fully. It is necessary to change the current situation that teachers as the center and students have poor active learning ability, it needs to be transformed into "the student mainly, teacher is auxiliary". For computer composition principle experiment , the design task should be distributed ahead of time, so let students have a preview design process, by thinking ahead, let students really understand the tasks what want to design, then design and finally complete the design and verification in class. Let the students to practice the skills of analysis, design, testing etc.

(3) Reform and exploration of the experiment content. At present, the content of computer composition principle experiment is mainly based on component experiment and the verification experiment, so after the students finished the experiment, they only knew the operation steps and the experimental results by the final verification. Therefore, it is important to reform the experimental project of computer composition principle, improve the experimental architecture, and increase the proportion of design and comprehensive experiments. In the experiment, it is necessary to increase the design part, set the thinking points and stimulate students' thinking. Through the project orientation, the analysis, design, experiment and study of the project are all around the main axis of the project, so that students can carry out this project through the whole process. Follow, the design,
reflection, verification and presentation of the experimental project must be demonstrated by the
design of four binary number adder.

Experimental content: design four binary number adder.

Experimental principle: The adder is the basic logic unit in the CPU. A and B are two addons, A_i, B_i
respectively is A, B’s the ith position, C_{i-1} is the carry in the i-1 position, C_{i+1} is the input to the high
level, S_i is the sum of the ith position.

Design process: First a semi-adder of a binary number is designed, the semi-adder is the uninitiated. The logical truth table for a semi-adder of a binary number is shown in Table 2.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>S</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
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<td>1</td>
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<td>0</td>
<td>1</td>
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</tbody>
</table>

Write the logic expressions of the semi-adder according to the truth table.

\[
S = AB + AB = A \oplus B \\
C = AB
\]

Design the schematic diagram according to the logical expression. The schematic diagram is shown in Figure 1.

Figure 1. Schematic diagram of the semi-adder.

A semi-adder is packaged as a corresponding symbol file for use later. The package diagram is shown in Figure 2.

Figure 2. Package diagram of the semi-adder.

Design a full-adder for a binary number, The full-adder is having an initial carry. The logical truth table for a binary number full-adder is shown in Table 3.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C_{i-1}</th>
<th>S</th>
<th>C_i</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Write out the logic expressions of the full-adder according to the truth table.
Design the schematic diagram according to the logical expression. A schematic diagram of a full-adder is shown in Figure 3.

A full-adder is packaged as a corresponding symbol file for use later. The package diagram is shown in Figure 4.

The four binary number adder is designed using a serial carry method of the full-adder, The corresponding logical expression is shown below.

The schematic diagram of four adder with serial carry method is shown in Figure 5.

Finally, the four binary adder was downloaded to the experiment box for verifying the correctness. The function simulation is correct, the design is completed, the module device enters the library, the manufacturer produces the corresponding chip. This is a good understanding of tasks, analysis, design, validation, and presentation.

(4) Research projects, innovative projects and open laboratories should be introduced to computer composition principles experiment teaching. Applied talents training target is layered, the basic good and students interested in hardware, you need to focus on training, so through research, innovation and opening experiments to further develop.

(5) The reform and exploration of assessment methods. The computer composition principle experiment basically is the open book examination class, therefore, the assessment mainly includes the attendance rate, the experimental report, the completion of the normal experiment etc, so this kind of assessment is difficult to separate the students' level and play the creativity of students. So the assessment must be add in innovative, research-oriented content, divide the student's ability level, develop students' practical ability, analyze ability and solve problems ability fully.
Summary
Exploration and reform of teaching mode based on the computer composition principle experimental. Firstly, this paper according to the requirements of applied talents training, expounds the problems of computer composition principle experiment course with the applied talents training currently. Then, aiming at the present situation and the problem, the paper puts forward some exploration of the practical teaching reform. Such as integrate hardware curriculum planning; play students' subjective initiative fully, it needs to be transformed into "the student mainly, teacher is auxiliary"; reform the content of the experiment, and rationally increase the proportion of design and comprehensive experiment; introduce the research, innovative projects and open experiments; adjust the assessment method, fully show the students' administrative levels.

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