Reform and Practice in the Course "the Principle of Computer Organization"

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Abstract—This paper introduces several new guiding ideologies in “the Principle of Computer Organization” course reform, based on the purpose of application-oriented personnel training, namely teaching according to the students aptitude, focusing on students’ capacity-building, emphasizing both theories and experiments. In the practice of curriculum teaching, we focus on the training and enhancing of students self-learning ability through group collaborative learning and examination reform. Meanwhile, we try to motivate the students to study with process management methods and course websites, thus the teaching effectiveness maybe significantly improved.

Keywords- Teaching quality; individualized; examination reform; group collaborative learning

I. INTRODUCTION

“The Principle of Computer Organization” is a basic course of computer science majors, which plays a role of linking in professional curriculum architecture. The course focuses on the basic concept, basic structure and working principles of the various component parts of a computer. It is not only the backbone of the hardware course, but also the base to further learn the knowledge of computer software. However, since the computer science major’s students in colleges and universities mainly get jobs in software design companies; the knowledge on the basic hardware is always neglected by us.

In order to train application-oriented talents with high quality in this situation, we should make our students to know much more about how the various parts of computer’s work together, and the relation between different hardware parts though practice, and deepen their understanding about the knowledge just like data stream, instruction flow and control flow after they manage to understand the basic knowledge and develop the fundamental skills. Then we can improve students’ idea of design and analysis, and promote their practical ability. But “the Principle of Computer Organization” is considered the course that is hard to teach for teachers and hard to study for students. In order to improve teachers’ teaching ability and perfect the teaching quality, lots of works of reform and research on this course have been done.

II. GUIDING IDEOLOGY OF COURSE REFORM

Curriculum teaching reform should be related with the objectives of a personnel training, and it should also focus on students’ capacity building. So we should combine education theory with practice, and be individualized to teach according to the students’ study abilities. Then we can keep improving our teaching qualities.

A. Teaching according to the students’ abilities

Literature [1] systematically analyses the teaching content and the display mode in the similar courses in almost 20 famous domestic and overseas universities, such as Carnegie Mellon University, Massachusetts Institute of Technology, Princeton University, Tsinghua University, Peking University. The conclusion is: the teaching contents have no big difference between the domestic universities and overseas universities, but in the organization of content and the hierarchical advancement aspect, there are some differences existing. Zhejiang University City College in which we are teaching is an independent college. During the past two years, all the enrolled students have a quite good entry score which is higher than most of the same type colleges, but the students’ study abilities are not very well developed compare with the famous universities. A same curriculum name, can be taught in varies ways, so “the contents of a hierarchical organization and promotion of the knowledge” is even more important. Individualized teaching is our basic guiding ideology.

The overall quality of the students in independent colleges is quite good. They always have active thinking and strong self-awareness, but their weaknesses are apparent, such as not firm professional foundation, poor self-control abilities and study motivation, weak comprehension abilities. For example, while a same concept or a principle is explained in a class, more time is needed to make students fully understand it. Take the author's own experience as an example, the introduction and explanation of a certain knowledge point to students need one hour in Zhejiang University, while in Zhejiang University City College; it usually takes about 2 to 3 hours.

In order to attain the teaching goal in limited time, it’s important to make some reforms according to the study abilities of students. Such as reorganize the teaching content in the proper way, lower the difficulties of some advanced and complex knowledge points, and reduce some non-essential contents.

The basic goal of course teaching is not the amount of knowledge but what basic thinking capabilities and the basic skills the students would have after study of this course.

Take the chapter “Operation and Arithmetic Logic Unit” as an example. In the section of “parallel multiplier and
divider”, the most important thing we should focus on is how to improve the speed of the computing with the concurrent design of hardware devices. So we can clarify the concept, ignore the content of “complement parallel multiplier”, which is complex to understand. We change teaching orders to move the section of “float point operation pipeline” later to chapter 4 which have more content about “pipeline CPU”. And what we should do is just show the basic concept when it comes to “Carry Lookahead”, we should make the students deeply understand the principle and the “level one lookahead mode”, however, the “two levels lookahead mode” need only general introduction rather than detailed anglicizing. The frequently teaching method mentioned is “refined teaching and more exercising”.It is unsuited to the anglicizing. The frequently teaching method mentioned is “two levels lookahead mode”, however, the “two levels lookahead mode” need only general introduction rather than detailed anglicizing. The frequently teaching method mentioned is “refined teaching and more exercising”. It is unsuited to the anglicizing. The frequently teaching method mentioned is “refined teaching and more exercising”. It is unsuited to the anglicizing. The frequently teaching method mentioned is “refined teaching and more exercising”. It is unsuited to the anglicizing.

B. Holding the basic knowledge

“The Principle of Computer Organization” is one of the backbone courses of computer science specialty. Using a view of hierarchy, the course introduces computer hardware structure and working principles with the main line of information processing. The students are requested to master the working principles of computer hardware parts, such as Arithmetic and Logic Unit, controllers, memory, input and output devices. The components working principle, logical implementing, system designing, designing methods and technologies, interconnecting and constituting a complete machine are included. This course involves a lot of basic concepts and basic analytical methods. It also contains a lot of concepts and basic skills. It can not only help the students to strengthen the fundamentals of program design, but also help them to set a better basis for the further studying.

“The Principle of Computer Organization” is not just the basic course of hardware, but also the basis of the software courses. Just imagine if one does not know how the CPU executes codes, how the memory manages addresses, or acquire other technologies like memory tracking, addressing, and so on, he would hardly find the problem when debugging a complex program error. Studying program is not only learning how to write codes; what is more important and should be learnt is how to think in program, namely programming thinking. Software system performance depends on the extent to which the programmer understands the hardware. Building system and the operating system both need the support of the computer organization Principle.

C. Focusing on abilities training

It is much more helpful for teachers to teach students some basic skills and tools which can help them take part in the computer profession works than to introduce lots of concept. There is no subject or technical method that never changes. The information technology is especially complicated, and develops so quickly that there is hardly any student who can acquire all the skills and knowledge during his campus time. So teaching students some general laws and basic skills can make students benefit from what they would learn in their whole life time[2].

“It is better to teach a man how to fish than to give him fish (Delegate to delegate to fish than fish)” Only by developing students’ ability to study, can we make them keep arming themselves with the latest knowledge they would learn in their jobs. During the process of teaching the course “Computer Organization”, we focus on students’ preparation for the class. We begin the class with students’ own report about the difficulties they meet while preparing the class. And then if it is necessary teacher can teach give lectures aiming at the problems mentioned in the report. At the end of each chapter, teacher organizes students to conclude the content of the chapter by searching for information, writing reports related with the chapter which would be published on the course’s website later. Assessment of the report is given by other students. In order to make the students prepare for their classes carefully and finish the chapter report, lecturers mark students score according their completion and classroom performance.

D. Emphasizing both on theory and experiment

The experiments teaching on course of “the Principle of Computer Organization” is one of the main parts of the course teaching. The main course purpose is to train the students’ ability to design, debug and develop the computer system. The teaching content and time arrangement must be set to keep a balance between the theory classes and lab classes. We should not only ensure most students to master the basic knowledge but also ensure some students who have better foundation to get further progress.

The course experiments are designed in 3 levels, i.e., verification labs, comprehensive labs and designing labs. Under the favorable situation of current verification labs with enough hardware basis, it’s important to strengthen the comprehensive and designing experiments, train students in basic skills, and enhance students’ abilities of system anglicizing, designing, problems solving [3]. We develop educational programs and do efforts to make each student to better comprehend and understand the relevant theoretical knowledge at different levels step by step, and in the experiments class the students understand and comprehend the teaching content further.

III. REFORM OF TEACHING METHODS

The course of “the Principle of Computer Organization” is always considered difficult for lecturers to teach. Firstly, the technological description to computer organization is the main part in this subject. There is neither step by step proving process like math course nor structure and algorithm introduction like data structure course. Without theories or principles to follow, students can hardly find an easy way to study the course better. Secondly, the course of “the Principle of Computer Organization” is a subject with a lot of concepts and technologies. What’s more, with development of the computer technology, the course is requested to develop simultaneously. Lots of new concepts and other things appear in the textbooks. Meanwhile, students are now know less about computer hardware than...
the students 5 years ago, so they are reluctant to get a class on hardware and learn relevant knowledge. The key to improve the quality of the subject teaching is changing the way this subject taught and encouraging students to improve their study ability on this subject.

A. Group collaborative learning

To encourage students to study and upgrade the quality of the subject teaching, we must change the traditional "lecturer-centered" way. But at the same time, as the administrator of the classroom, when facing the limited class time and a mass of teaching contents, the teacher is supposed to plan and design the reasonable teaching approach to focus on the students to form a "student-centered" environment. Group collaborative learning method is developed in which all the students are divided into several groups and study activities are organized in groups unit.

1) Preparation and discussion

To train students' capability of studying by themselves, we assign works to students to prepare for the next lesson in each class. Then at the next class we will begin the class with questions required and ask the appointed group to answer the questions. The group students would be request to introduce the main points of this class and the difficulties they encountered in preparing the class. By this way, teachers can guide students to keep finding questions, asking questions and solving questions through thinking by themselves. Students also show their characteristics by trying various ways and methods to solve problems. And then what the teacher should do are instruction, summarization, extraction and sublimation. Students' strong desires for knowledge are inspired to develop their creative thinking in this way. Meanwhile, the classroom discussion is held in groups, the competitions between the groups will make the classroom atmosphere more interesting since students like this kind of education, they will not only be willing to know more about this subject but also get a new ideas about what they have learnt.

2) Summarization to each chapter

At the end of each chapter, students will be asked to conclude the main idea of the chapter through searching information and write the report in groups. The report’s content can be summary that students have learned from the lessons or some extension to the class teaching. Then we will publish these reports on the web, and ask the groups to evaluate the quality of the report. Finally the group which wrote reports can get the score from this as part of their performance.

3) Learning from each other

Since we take the difficulties of this subject’s study into consideration, the study group should be a team in which every student could learn from each other, and get help from each other. So a relatively excellent student is selected to be the team leader (this is also one of the necessary condition to apply being excused from final exam). By this way we organize the good student to help others in his group, and then enhance the overall learning outcomes.

B. The reform of the exam

In order to further train students’ abilities of self study and creativity, a new exam pattern is introduced in this course, i.e. exams are carried out at different levels. The students who get a score in the best 20 percent in the midterm examination, can apply to be excused from the final exam. With the teacher’s approval, they needn't take the final exam. In order to bring the students in the same group to study together, the students who want to apply to be excused from the final exam should take the responsibility of the leader in their groups. Then the students who get the agreement from teachers do not need to take the final exam but they should finish a course paper by searching the newly computer organization technologies and doing some research. At the end of the semester, they are asked to give the presentation of the papers to the all students in the class.

From the past 4 years' experience, through this kind of reform, most of the top 20 percent good students can not only finish studying the course, but also learn more new knowledge through the deepened study than others. The process of writing papers can also broaden their scope of knowledge. What's more through the designing experiment work, students’ ability to use their knowledge comprehensively is greatly improved and their creative designing ability is trained a lot as well. The teaching quality of this method is quite reputable for students and also highly evaluated by the college administrator team.

Most students take part in the final exam which is executed following the 4 approach-unification course rules. The final exam paper keeps the balance of the width and the depth of the course knowledge with less rote learning questions, which guiding students to learn more in their spare time. The exam paper mainly consists of the concepts and teacher instruct in class. We emphasize on the capacity of applying the knowledge.

C. Strengthening of the procedural administration

As a fair approach to evaluate the students’ study, the exam should be Authoritative. But what the study stresses is the procedure, and the exam is just a way to judge the procedure. If attaching importance to their study procedure, most of the students will get a good result from the exam.

In the teaching process of this course, we raise the percentage of their classroom performance and homework to the final score to emphasize the procedure administration to encourage students to study. The percentage of the final exam in final score is reduced to avoid the phenomenon that the score of the exam directly determine whether the students pass or fail. The final score of the course consists of the following parts: 30% based on classroom performance, homework, chapter exam and attendance, 20% coming from mid-term exam, and final exam taking up 50%. The evaluation of the 30% classroom performance and attendance part is as follows. After 3-time tests, the 30% is divide into 3 part: chapter test score, homework and classroom performance take up 10% of the total respectively. The performance in class includes report preparing, question asking, and the work done in the course website. The score of the experiment is completely judged from experiment
tests and the reports. A comprehensive experiment done by the students at the end of the Teachers will keep an eye on them to avoid plagiarism and mark all the experiment report one by one.

D. Making full use of the course website

“The Principle of Computer Organization” course website is developed on the campus LAN which provides teaching resources to the students and lecturers. As the supplement to classroom teaching, the website provides a spare time self study platform for students. Lots of teaching resources are listed on the website, such as curriculum syllabus, teaching plan, coursewares, teaching supplementary material, students course papers, experiment CAI software, experiment tools kit, template of experiment report, course news and so on. What’s more, a separate self testing platform is linked to the resource website. It can both play the role of the homework supplement and the review to the class teaching. Another feature is that on the forum teachers can answer questions online and students can discuss problems. So it seems that this website build a classroom outside the class for us all. Students and teachers can be interactive by discussing, debating, and even chatting about course related topics online which is very necessary for us to build a congenial atmosphere.

The website provides us a modernized platform for teaching and studying. Teachers should try to design and update the web contents to attractive and encourage students to study more knowledge about this subject to train their study abilities. Now we put the course papers which are written by the students previously for students to study outside the class. And on the other side, the forum that we provided allows students to login in only by their real names. They are asked to post their group course papers on the forum and evaluated by other students. If a report is highly evaluated, teacher will give them some extra marks, and at the same time the behavior on the forum is related to their performance marks. In this way, teachers can administrate students’ spare time studies and also build a better teaching atmosphere.

IV. Conclusion

Curriculum construction should be centered on specialty cultivating targets. Through past several years’ efforts, with the teaching purpose of training students’ professional abilities and the emphasis put on the foundation and study abilities, the course of “The Principle of Computer Organization” is set as Quality Courses of Zhejiang University City College. The teaching quality of this subject is highly evaluated by students. We take advantage of the Computer Application Innovation Platform to carry out some practice and creative activities. Instructors directed students to join the “IEEE Standard Micromouse” competition and won excellent result. The students self designed micromouse won the unique Special Creative Prize in the 2009 National Micromouse Competition.

With the development of the computer technology, “the Principle of Computer Organization” course construction is still a job which will last for a long time. It needs us to keep on researching on the teaching methods, teaching contents and experiments architecture, so that we can improve the teaching quality and satisfy the needs of the specialty development and the talent cultivation.

References