Integrated Educating and Practicing of Programming Design Ability Based on CDIO

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Abstract. The ability of programming is a needed skill for students who are majoring in computer science, or students who are not majoring in it. It is very important for the learning of the following courses and the culture of the skill. How to cultivate students' programming ability and interest and sustainable development is very important and necessary.

Combined with CDIO engineering education concept, the integrated programming design ability culture was proposed. That is to improve students’ interest in programming and the ability of program design. The integrated culture of “application system, function module, the basic unit” is the main line.

The organic combination of theory teaching and practice teaching, the organic combination of knowledge learning and quality, ability to ascend, the organic combination of in-class and after-class, form the systematic integrated culture mode.

The learning effect was good in courses related with the programming design after the implementation of CDIO. Students generally felt that the programming ability improved, teacher also felt that programming ability of students was better than before the implementation of the integration of CDIO.

Introduction

At present, most schools let “C language programming” as the basis of computer professional courses to learn, to carry out the corresponding program design and training.

However, an interlacing as foster, everything is hard in the beginning. Due to the complicated concept and rules and different, flexible use of C language, it is more difficult for fresh students to learn.

Students in study often can’t debug the correct program because of compile errors. Or because program is complex, the idea is not clear, the ability to find the wrong problem is not good, and so on. These make students think programing design is difficult to learn and have the emotion of fear, even give up their efforts for it. This will also influence study in the follow courses.

Secondly, programming design ability needs a long time continuous system of training, step by step to allow students to fall in love with programming, improve programming ability, and has a long-term sustainable development.

CDIO Engineering Education

CDIO Engineering Education model is the latest achievement of international engineering education reform. In the life cycle of product research and development to run as carrier, it let the students learn and obtain the ability of engineering by practice, the organic connection between courses.

In CDIO training outline of engineering, graduates ability is divided into engineering basic knowledge, personal ability, interpersonal skills and team systems engineering capability. The
requirements of the outline enable students in the four aspects to achieve the intended target by comprehensive training.

Under the guidance of this innovative concept, curriculum group, from the beginning of 2008, not only fully adjusted the teaching plan, teaching outline, but also put integrated CDIO teaching ideas into daily C language teaching, with the C language programming as a breakthrough.

This model enables students to understand and master the basic concept of C language and programming from multi angles, multi ways and it is committed to training students to use C language to solve practical problems, cultivating students’ learning initiative. The process of problem solving experience lets students master the basic design procedure and methodology, and allows students to gradually fall in love with program design.

Therefore, based on learning and digesting the concept and standard of CDIO, the curriculum group put forward the integrated programming design ability training system and the integrated learning experience of the specific course.

Training Plan and Implementation of the Integrated Programming Ability

An integrated training plan is a program designed by support each other's professional courses and clear personal, interpersonal skills, product, process and system building skills.

The integrated curriculum planning forms an educational system that overall effect greater than the sum of its parts. The education system is coordinated with well understood and mutually supportive elements. Each element has its own specific functions, and all the elements work together to ensure students to reach program learning outcomes.

Training Plan of the Integrated Programming Ability

Programming ability is a long-term, continuous process, a continuous line throughout the school period and a continuous training and strengthening process. The integrated curriculum program, which includes an introduction course, a variety of courses, professional courses and implementation of the project. To this end, throughout the understanding, research and research related to the experience of the actual experience of the engineer's comments and suggestions, the curriculum group resort curriculum system of programe design capabilities, as shown in Fig. 1.

![Programming design course system](image)

Figure 1. Programming design course system.

Freshman first semester began to open the “introduction engineering”, to introduce the basic idea of program design and algorithm, to guide the interest; Open the "C language programming" to solve the basic programming ability. Engineering practice 1 will be opened during the first summer holiday.
In the second school year, Database, data structure, object-oriented programming and engineering practice 2 will be opened, to solve the object-oriented programming ideas, to applicate the knowledge in the project.

In the third school year, soft engineering, algorithm analysis and advanced programming will be opened.

In the fourth school year, engineering internship will be opened to help students solve the practical problem with the knowledge they have learned.

**Implementation of the Integrated Programming Ability**

Integrated teaching plan will eventually be implemented in everyday teaching. In the implementation process, the main line is “applied system, functional module, fundamental unit”; Academic teaching and experimental teaching; knowledge learning and ability improvement; curricular and extracurricular learning are combined to be an integrated systematic ability training mode. “C language programming” was break-in point in many courses to help students apply the knowledge in engineering practice.

**Adjust the order of courses, improve the learning interest.** The entire course is divided into 4 main parts, includes the three foundational structures, modular, information serialization and synthesized application of programming. Besides, synthesized application takes part in training all the time.

The main line of the curriculum is still teaching. Each class is powered by applied system or mission, such as prize-drawing system, tax-calculating system, random choice system, online-vote system and simulated automatic teller machine, to attract students to focus on the classroom, to stimulate their motivation to learn, and guide to explain the corresponding points of knowledge and to discuss the case demonstration, with the practice and other forms of church.

For example, to explain the specific string, first of all, given the task, as shown in Fig. 2, guess the word game, in the demonstration of the process of guide students to discuss how to describe the game, how to describe these questions, how to store the answers to these questions, how to test is correct or not? Whether the existing knowledge reserve can be completed? Do you need to add new knowledge to guide them to understand what situations need to use a string, how to use.

**Figure 2. Guess the word game.**

**Combine teaching in the class and learning after class.** Class is extracurricular foundation, but it is not enough. In order to encourage students to have a positive attitude, and actively participate in the activities of the school, also stressed to strengthen the learning of other courses, such as math, English and other courses of learning, these will have a great help to improve programming ability. The corresponding engineering capabilities and literacy will be gained through taking the initiative, practicing, organic link between the curriculums.
Students can download the courseware, resources, submit the electronic work by the campus network. The corresponding exercises and self-testing by calculating the center of "C language practice and examination platform".

**Integrating theory with practice.** Programming is a very strong practical course, but also an accumulation of the process, focusing on the accumulation of the usual drip. It is very important to strengthen the training of process management and strengthen the normal training, which is very important for students to have a sense of achievement.

Each chapter experiment has specific requirements, taking into account different students of each chapter are decorated with optional problem, the topic of your choice, and having test at the end of practicing class.

On the purpose to apply what they have learned, the engineering practice of "C language programming" was laid down, through the whole C in the learning process, based on task driven, decomposition of refinement, bottom-up and top-down combined to mobilize the enthusiasm of learning, staging submitted the corresponding operations on time. And also encouraged students to participate in the school's "C language programming contest” actively.

Through participation in work, works submitted and competitions, students have a sense of achievement, and love in programming. They think programming design did not imagine so hard and overcome the difficult emotions.

**Cultivate the Spirit of Cooperation with the People, Pay Attention to the Long-Term Sustainable Development of Students**

The spirit of unity and cooperation are advocated by CDIO. Maybe in a casual conversation with others, you can burst out the spark of inspiration. To read, to discuss more and more, to compare who is more excellent on the same issue, to learn from each other through self-assessment and teacher assessment for students.

As far as possible, to choose concise, easy to understand, lively and interesting examples instead of obscure examples, which is a better way to stimulate the students' learning initiative, to efficiently improve the quality of teaching and to gain a satisfactory teaching effectiveness. Let the students learn lovely, learn how to learn, conscious learning, training students long-term sustainable development.

**Summary**

In the end, through formulation and implementation of the integration programming ability plan, giving full play to the teacher's leading and the student's subjectivity, with students as the center, making full use of various teaching and practice link, the student's ability of programming and autonomous learning were improved.

After several years of efforts and endeavoring, and with the guidance of the teacher, students achieved a better learning effect through learning, active practice based on the integrated case and the project. Students generally believed that the programming design is not that difficult as imagined, to overcome the fear of difficulty, enhance the self-confidence and the study interest; enhance the self-learning ability, the analysis question, solve problems, and cooperation and communication ability; Student satisfaction was continuously improved, other follow-up courses teachers also felt that students' basic programming skills were improved and had a good foundation for the future study. The employer of students was also quite satisfactory, through several years of training.

**References**


