Research and Exploration of C++ Programming Teaching in a Sino-foreign Cooperation Program of SPU

Xiao-hua XIONG*

College of International Higher Vocational Education, Shanghai Polytechnic University, Shanghai, China

*Corresponding author

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Abstract. The Internet Service Technology (IST in short) program is a joint cooperation education program between Shanghai Polytechnic University (SPU in short) and Broward College (BC in short) in USA. The training objective is to cultivate IT talents with international views. C++ programming is one of the specialized elementary and needs been taught in English. The paper identifies some of the special challenges facing the design and delivery of such a course in the Mainland Chinese context. And it provides some novel ideas on constructing a reduced curriculum content system which is based on enough for use concept, and a spiral practical teaching mode with imitation, rewiring and programming three steps. The analytic work is aimed at rendering some thoughts on improving the teaching quality of C++ programming in higher vocational education designed for Sino-foreign cooperative program’s students.

Introduction

In order to construct the modern vocational education system and cultivate more talented graduates with higher vocational skills and a strong international competence, Shanghai Polytechnic University and Broward College in USA began a joint education program on Internet service technology since 2015. It is a three-year associate degree and qualified graduates will receive two diplomas-one from SPU and one from BC. And all courses. Since it is a Sino-foreign cooperation program, students are designed to transfer to USA to fulfil their bachelor degree. The specialized courses have the same requirements as BC faculties do. Our Chinese faculties are required to use same original English textbook and all teaching materials should be written in English. It is a great challenge not only to students at vocational college but also to our faculties whose English is a second language. C++ programming is a specialized elementary course for IST program. It is the first programming course to cultivate students’ ability on computational thinking and master the general method of program design so as to creating programming idea [1-3]. It plays an important role for the subsequent professional courses. Learning C++ programming isn’t an easy job to most of vocational college students with native language, let alone with a second language. This paper is engineered to share some practices and experience gained from teaching C++ programming in a joint program at an associate degree level. The major efforts of this paper are devoted to rendering some thoughts on improving the teaching quality in C++ programming designed for Sino-foreign cooperative education program.

Existing Condition Analysis

C++ programming is the first course to introduce programming to students and help students form programming ideas. While in our teaching process, there are several problems need to be solved.

Theory Teaching Oriented and Experiments Replaced by Demo Experiments

In the Sino-America joint program, the C++ programming uses the same textbook as BC’s faculties do. It is the eighth version of Starting Out with C++: From Control Structures through Objects written by Tony Gaddis. Too many concepts and syntax rules are one of the outstanding
characteristic of C++ programming. There are more than 18 chapters and covered almost every aspect of C++ programming. The wide coverage of contents and the limited time for the course severely affect the teaching and learning. In order to complete the teaching outline, our faculties try their best to finish all teaching contents in the limited credit hours. Sometimes students couldn’t digest the teaching contents and teachers have to compress practical teaching or use demo experiments as practical teaching. Practical teaching has same or more important role than theory teaching. Students as beginners of programming, though there are so many knowledge points in C++ programming, they couldn’t use all the knowledge points in their program. On the other hand, some knowledge points will be covered and strengthened in the subsequent courses. C++ programming itself is hard to students, in addition to teaching in a second language-English. Some students lose their interest on programming because the first programming course. Something needs to be done to protect our students’ interest on programming.

In Short of Practicial Teaching Materials and Teacher-oriented Practical Teaching

In short of teaching materials in English is one of our problems. Our teachers only have one original English textbook. And other teaching materials need to be built from scratch. Now we have designed an experiment instruction on the knowledge points of each chapter. Without enough practical teaching materials, it is hard to elevate our teaching quality. In the procedure of practical teaching, students are reluctant to think by themselves and like to ask teachers for answer whenever encounter a small problem. Teachers are always the center of the practical teaching. There are something needs to do to change our teachers from the dominator to spectator in practical teaching.

Week Curriculum Evaluation System

C++ programming is a required professional foundation curriculum, which requires students not only to master the basic knowledge and concepts, but also to cultivate students’ practical programming skills. To improve the quality of teaching, we need a scientific, standard and refined management to the teaching process, and establish the quality evaluation system which can reflect learning effect, can assess students’ learning ability, practical ability, problem-solving skills and learning attitude, etc. It should emphasis on students’ practical skills and abilities of analysis and problem-solving.

The former examination of C++ programming is a single written test and students’ final grades are determined by only two parts: the written exam and regular scores. One of the most important training objectives is cultivating students’ programming ideas. So students’ programming skills should be an important part of our assessment.

Reform on Teaching Organization and Teaching Ideas

Construction of Curriculum Content System-Four Three Curriculum Content System

The Selection of curriculum content is vital to the quality of higher vocational talents training. C++ programming course, as the first course to introduce programming, has too many knowledge points. Affected by the exam-oriented education, some teachers focus on lecturing basic syntax of C++ programming and try to explain all knowledge points in the class. And lecturing hours account for a large proportion of total credit hours. C++ programming is a course both focus on theory and practice and in some way practical teaching plays more important role than theoretical teaching. In this mode students are the passive receiver without considering the students’ individual requirements. Students may feel tired to absorb all the knowledge their teachers try to send. And the worst result is that students may lose the interest to learn the course. In addition to teaching in English, it is really a formidable task to our students. We need do some changes and construct a new curriculum content system to overcome the current situation.

Teaching contents will directly affect the quality of teaching quality. There is no need to try to give all knowledge points to students in one course otherwise those knowledge will become a burden to students. C++ programming is the first programming course for these students. To the
theory study, we have a principle of Necessity and Enough for Practical Use. The whole knowledge points are divided into two parts. Those knowledge points, which are rarely used by beginners or will be taught on the following courses, can be used as students' after-school self-learning contents. For most of students, these knowledge points will hard for them to grasp in one course [4].

In order to save beginners from learning all theory knowledge, we reduce the teaching contents to four parts, which are necessary and enough for a beginner on programing. The first part is the three fundamental data types-\textit{int}, \textit{char} and \textit{float}. In an exam-oriented teaching mode, teachers will explain a lot of data types to students and use bunch of slides to explain the difference between them, like short \textit{int}, \textit{int} and \textit{long int}. For a beginner, the three data types are enough for them to use in their programs. The second part is three simple flow control statements in structured programming-\textit{sequence structure}, \textit{branching structure} and \textit{loop structure}. Though C++ programming language is also an object-oriented language, we will leave the object-oriented part to the following course. The third part is three user-defined data types-\textit{structure}, \textit{array} and \textit{pointer}. Structure is a group for a collection of values of different data types. Array is a group of a collection of values of same data types. And pointer is a construct that gives user more control of the computer’s memory. And pointer is a very important part and difficult part of C++ programming. The three user-defined data types will allow C++ has many compound data types. The final part is three programming framework-\textit{function}, \textit{variable's scope} and \textit{file}. The reduced curriculum content system has a clear structure and students will have more confidence on learning programming.

\textbf{Reform on Practical Teaching}

C++ programming is the first course used to introduce programming to students. The main purpose of the course is to help students to form computational thinking and master the general programming method so that students have basic programming ideas. The creation of computational thinking and programming ideas needs a lot of programming practice. Without practice students could never learn how to program. Practical teaching plays a very important role in C++ programming course. Something needs to do to drive students to solve some problems in real life with programming. Students will have more interest on programming during the process of solving problems using programming.

We revised the experimental teaching plan and syllabus. According the doing by learning and learning by doing, the principle of engineering education, the teaching contents in practical teaching are designed in four types. Firstly, teachers demonstrate some simple programs and explain them to students so that students can imitate from these programs. Secondly, students are required to design some simple programs which only have some modification on certain function with those programs in first step. Gradually, students can design some bigger programs with dozens of lines of code or nearly one hundred lines of code under the instruction of teachers. Finally, students can perform a project with thousands lines of code at the end of the course. In the imitation process, teachers demonstrate how to program to solve problem face to face and students learn the programming skills from it. In the rewriting process, students use the programming skills learned from the first process, they program to solve some problem face to face and students learn the programming skills from it. In the programming process, some more complex problems are presented to students. Students will try all the comprehensive programming skills to solve the problems. They may encounter some difficulties while the teachers are their strong backing. When they really solve a problem with programming, the sense of achievement will arise more interests in students and students won’t feel frustrated when they encounter new problems. Those difficult or important knowledge points are practiced repeatedly. The imitation, rewriting and programming process is a spiral practical training mode and gradually cultivates and improves students’ comprehensive ability in the process. And it is also a good way training and cultivating students’ innovative thinking in programming learning. At the
end of course, students need do a final project which maybe contain more than one thousand lines of code. Students’ innovative thinking will do some excellent projects from them.

Since the limited hours of practical teaching, our teachers have some extra office hours to help students solve problems. And students will easily ask questions to our teachers online via our course website or popular social media software, such as QQ, wechat, etc. Students don’t need hesitate when they need teachers’ help.

Reform on Curriculum Evaluation System

Effective assessment methods determine quality and improve the learning process. We adopt the curriculum appraise system from BC, which is a formative assessment. Formative assessment is aimed to enhance the learning process guidance and management, timely feedback study information to teachers, improve the comprehensive quality and ability of students. Formative assessment refers to assess the whole learning process and phased examinations for students studying.

The formative assessment of the curriculum generally includes the schoolwork assessment, final project evaluation, students’ learning process monitor, and the final examination. Our final exam is based on computer. The final grade consists of three parts: the final exam grade, final project work and the regular score with the ratio of 3:3:4. And regular score includes two parts schoolwork and students daily performance. Since final project work is done out of class, maybe there will be the phenomenon of plagiarism, so the final test on computer is a way to improve the fairness of the assessment system.

Provide Students Additional Learning Resources

Provide students with a number of well-structured learning resources will make learning easier for them. In short of teaching materials is one of problem in our program. In the Sino-America joint program, students study EAP (English for Academic Purpose) for 12 credit hours. Their English still have problems in learning a professional course like C++ programming. We will provide a list of specialized vocabularies so that they can look up when they read the original textbook [5]. We provide a number of programming examples on the course website for easy acquisition. And a test bank about the basic conceptions and syntax rules is also provide on the website. Students need to test by themselves to know whether they master these knowledge points or not. Enough learning resources will be a great help to reduce students learning time, reduce some duplication programming work, more importantly, they can improve students’ interests and achievement.

Summary

Teaching C++ programming course in English in a higher vocational college level isn’t an easy thing. We analysis the problems existing in the practice of C++ programming course of our Sino-America joint program. This paper is expected to contribute some practical notes on C++ programming in English teaching at higher vocational college level, and to attract more technical attention from the fellow faculties nationwide.

Reference


