Preliminary exploration on teaching reform of "C language programming" course

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Abstract: "C language programming" is a practical course, which aims to cultivate students' ability to solve practical problems with programming thinking. However, there are some problems in the real teaching process, such as less class hours, single evaluation method, students' lack of interest in learning and lack of cultivation of practical ability, so the teaching effect is not so good. This paper analyzes the causes of these problems and gives some reform measures, hoping to provide some references for the improvement of students' practical ability, the development and preferment of C language teaching in colleges and universities.

1. Introduction

At present, the whole society has gradually entered the era of artificial intelligence (AI).The core of AI, based on computer science, is programming thinking.

Learning program design courses can well cultivate students' logical thinking and innovation ability. Except assembling language, C language is the closest program design language to hardware. It can provide accurate control of operating system and memory with high operating efficiency. And it's still irreplaceable in embedded systems and other fields.

As a classic computer programming language, C language is the first important basic programming course in the undergraduate stage of most science and engineering majors in domestic universities. It can not only meet the basic requirements of modern programming, but also serve as the basis of many other programming languages (Java, C++, etc.).Teaching college students how to use a programming language, the important thing is to let students learn to use computer thinking, to improve the ability of logical thinking, and to master the use of programming language to solve practical problems[1].

2. Current Teaching Situation

C language course, as a classical program introduction course, has the advantages of strict logic and strong practicality [2]. However, there are some problems in the actual teaching process, which

mainly include the followings:

2.1. Too many contents but relatively few class hours

At present, the total teaching hours of most universities are about eighty hours, and half is for teachers' theoretical teaching and half for students' computer practice. Some even set fifty-five hours for the total teaching hours. But, C language has so many relatively abstract concepts, and this is the first time for the students to learn programming curriculum, the teacher lecturing full of knowledge at one time, so it’s hard for the students, whose understanding is so rare. Then the students’ conscious, enthusiasm is not high in practicing process, so the teaching effect is obviously not good.

2.2. Lack of initiative in learning

In the actual teaching process, the author found that some students are easily frustrated once they encounter the learning bottleneck, usually lack the spirit of hard work and easily give up learning. The content of C language programming has a strong continuity. The failure to understand one or two concepts will directly affect the effect of follow-up lectures. Even if students want to learn it well, incomprehension directly frustrates students' enthusiasm, resulting in serious polarization of students' performance.

2.3. Poor problem solving ability

In the process of learning, students usually learn in an unscientific way, focusing on the learning of grammar knowledge rather than the learning of program debugging method, which leads to low awareness and level of program debugging.

2.4. Insufficient emphasis on courses

The students think, "C language" course is one of the foundation courses, but it is not the current popular programming language, it is not the basic skill when working. Also they don't understand how is the relationship between employment and C language in the future, so insufficient emphasis is focus on this curriculum, and a vicious cycle, no preview before class, not carefully listen in class, no review after class, is formed, therefore the teaching goal is very hard to complete, and the teaching effect is greatly reduced.

2.5. Single mean for assessment

The traditional assessment of this course is not sufficient; it cannot mobilize the students’ interest. Traditional assessment methods include class attendance, experiment report and examination results. This assessment mode can urge students to attend class on time, but cannot guarantee class efficiency. It can urge students to complete the experiment report, but the experiment report cannot reflect students' practical ability, and cannot guarantee all the students to complete the experiment independently, so it cannot reflect students' learning effect. Most of the exam contents are limited to the basic theory and basic skills in textbooks. So the students are limited to memorizing standard answers according to knowledge points, and the training of application ability, analyzing and problem solving ability cannot be verified.

3. Reformation

Therefore, how to let students master C language programming, explore students' enthusiasm and improve students' software skills under the condition of limited class hours is a crucial issue. The C language course group of our school has made the following reform attempts.

3.1. Design of teaching mode

In the teaching of C language course, the mode of ability-oriented, case-driven and supplemented by basic explanation is adopted.

According to personnel training objectives, the C language knowledge and ability goal system is divided into eight ability modules and their corresponding ability points, as shown in table 1. The course is divided into three levels: basic, intermediate and advanced, each stage focus on variables, statements and functions, to deepen students' grasp of knowledge. The whole teaching process is mainly project-driven and supplemented by basic explanation. Appropriate classic cases are selected for the basic and intermediate levels, step by step, from the shallow to the deep; At the advanced level, the consumers' credit management system is adopted for teaching, and the students' score management system is used for practicing. Both the consumers' credit management system and the students' score management system closely focus on the programming ability of C language and combine the seemingly isolated knowledge tightly to help students organize the overall teaching context. This project-driven method can make the students to understand and master the relevant knowledge in a short time, and for reference, students can practice independently and positively, so that the students' knowledge of C language is better mastered, practical operation ability is reinforced.

Table 1: Capability module and its corresponding knowledge and capability

Ability module	Knowledge points	Ability points
Computing thinking capability	the concept, essence and application of computational thinking	Can solve practical problems in life. Understand what is computing thinking
Computational description capability	Problem algorithm description, flow chart	Be able to enumerate the procedures in life, give the algorithm description to solve the problem, and draw the flow chart.
Simple data Processing capability	Main function, input and output, comments, data types, variable, constants, and basic operations.	Can use format input and output function to input and output any type of data in programming language; Master simple programming.
Structured programming capability	if、switch、while、do-while、for、break and continue	Can use various branches and loops of flow control statement in programming
Aggregate data operating capability	One dimensional data, multidimensional data, character array	Should be good at operations such as array value, array length, traversal, sorting and so on.
Modular programming capability	Function definition, parameters' and non – parameters', local and global variables	Can abstract real life problems, modular solution, form a functional way of thinking.
Complex data processing capability	Pointer variables, pointer parameters, arrays and Pointers, structures, enumerations	Master the method of using pointer to access ordinary variables and array elements, and use pointer as function parameters; Can use structures and enumerations in programming.
Document processing capability	Read and write files	Be able to open and close file, read and write files

3.2. Use of various means and methods

Various teaching means and methods are used for improving.

3.2.1. Application of interactive platform

The online resources of the course are shared in the form of WeChat official account. Teachers can use this platform to issue notices, share teaching materials, arrange pre-class thinking, after-class consolidation exercises and tests.

The interactive platform mainly provides three functions.

- Course materials are shared, including course outline, courseware, mind mapping, and other materials needed before and after class.
- Small practicing tasks and operating or explaining videos are shared, through this process, the students have accumulated a wealthy experience in programming and their operational ability will be improved.
- Push the tests according to the core knowledge points. After consolidating and reviewing relevant knowledge points, students come here for testing. After submitting, the results and answer analysis are displayed.

In addition, WeChat communication group has been set up for answering students' questions in time. Teachers in the course group take turns to interact with students, which promotes the interaction between teaching and learning, and creates a good learning atmosphere.

3.2.2. Adoption of mind mapping

Mind mapping is an effective graphic thinking tool to express active thinking. Mind mapping is a simple but extremely effective way to show the relationship between different levels of themes by using hierarchical maps that are subordinate to each other and related to each other, and to establish memory links between theme keywords and images and colours[3].

This course group has drawn a complete set of knowledge point mind mapping for the content, and the teachers of each theoretical class use local mind mapping to carry out the teaching process. For example, figure 1 is a mind mapping of points' basic concepts. Before class, students are required to draw a mind mapping according to their own preview, so as to drive students' to study independently, inspire their learning interest and cultivate their subjective initiative. In class, the teachers make comments on several selected students' mind mappings and discuss with students, then assign homework for the students to modify their mind mappings. At the end of a whole knowledge course, students are required to summarize chapter thinking mappings, so that students can gradually establish their own base of C language. A small mind mapping is not only convenient for teachers to prepare for classes, but also for students to learn and consolidate.

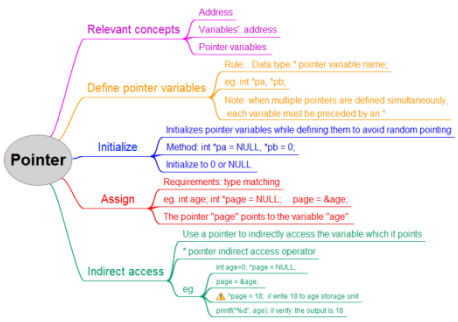

Figure 1: A mind mapping of points' basic concepts.

3.2.3. Collection of compiling errors

According to the author's many years of frontline teaching, students are more likely to give up in practical courses. After editing the program, students will encounter various compiling errors when compiling the program. However, the compiling errors in the design environment of C language are all prompted in English, which undoubtedly adds a lot of difficulties for students to debug.

In order to make up for the shortage of theoretical class hours and practical class hours, improve students' programming and debugging ability, raise teaching quality, and meet the needs of the industry for training programming talents, this course group made a try.

In the programming process of C language, three kinds of errors are commonly encountered, namely, syntax error, logic error and running error. Due to the large amount of grammar in C language, students' basic grammar is not clear, resulting in improper grammar expression and disordered sentence order, which leads to compiling errors. Wrong logic expressions and illogical statements make an unexpected result when debugging, even if the program can run normally. The program stops running or an error occurs suddenly when it is running without a syntax error or a logic error. Generally many students' are not good at English, so they can't understand very well the prompt information in debugging, which leads to improper program modification and debugging, so the program written by themselves can't run out with expected results. Over time, students' enthusiasm to learn this course is discouraged.

Therefore, at the beginning of the course, students are required to collect every programming error, take screenshots when necessary to explain this error, analyze the cause of this error, and state the solution, and submit an electronic document of each practical class. At the end of the course, students are required to put these documents together into a book. On the other hand, the teachers classify the errors after every submission, select common error cases to discuss with students, and put forward corrections. In this way, students can avoid making the same kind of mistakes in the programming, discover their enthusiasm in correcting mistakes, improve their debugging ability, and establish good programming habits.

3.3. Application of multiple assessment methods

The course group on the basis of fully research put forward the curriculum evaluation system of "students' active learning as the guide, ability evaluation as the core” in a manner of processing examination and final examination. And processing evaluation mainly includes ordinary tests, periodical exams and ability evaluations Usually ordinary tests mainly examines the students’ classroom learning and participation, the mind mapping drawing; Periodical exams mainly carry on the stage examination to check the study effect in basic grammar knowledge; The ability evaluations are oriented by the summary analysis of programming errors and the process and results of practical tasks, and mainly focus on the students' practical operation ability, programming ability and program debugging ability.

The final examination will be conducted at the end of the course, which will examine students' mastery and familiarity with the basic concepts of C language, comprehensive application of the basic knowledge, comprehensive program design and debugging ability of C language.

4. Conclusions

Above all, in order to improve students' programming ability of C language, improve the teaching effect of the course, the teachers guide students to draw mind mapping, and help them build their own knowledge system; Use WeChat public account interactive platform to share course materials, use WeChat communication group to create a better learning atmosphere, use case-driven

teaching method to promote students' learning enthusiasm; guide students to collect compiling errors which is beneficial to the establishment of students' procedural thinking and the improvement of their procedural design ability. Use multiple assessment methods to facilitate the comprehensive evaluation of students' mastery of C language and their ability to comprehensively use C language to solve practical problems. Through the above measures, students' learning enthusiasm has been significantly raised compared with previous generations, students' practical ability has been well exercised and improved, and C language teaching has also achieved remarkable effects. However, the exploration of teaching reform is a long process; teachers should continue to summarize and improve the teaching methods, teaching strategies and other aspects, so as to stimulate students' ability to think more effectively.

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