

Reform in New Engineering and Technical Disciplines

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Abstract

Background/Objectives: Under the background of new engineering and technical disciplines, the demand for talents is getting higher and higher. As colleges and universities, how to cultivate qualified talents for enterprises has become a hot issue today. **Methods/Statistical analysis:** For the undergraduates majoring in computer science and technology, software engineering and e-commerce, programming courses such as C language programming are the most important part of their training. **Findings:** The traditional teacher-centered way of teaching has seriously limited the role of the core courses of this kind of specialty, and cannot give full play to the initiative of students, so it is urgent to change the way from the original teacher-centered to student-centered, and carry out innovative teaching reform. **Improvements/Applications:** This paper is written with the teaching reflection and practical experience in recent years. And tries to explain the innovative methods and achievements of this course in recent years, arouse people's thinking and discussion, and jointly promote the development of this course and related majors.

Index Terms

C language programming, new engineering and technical disciplines, teaching reform, teacher-centered, student-centered

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I. INTRODUCTION

C language programming is the first professional basic course for students majoring in computer science and technology, software engineering, e-commerce and other computer-related majors. The class hours, credits and course categories are shown in Fig. 1.

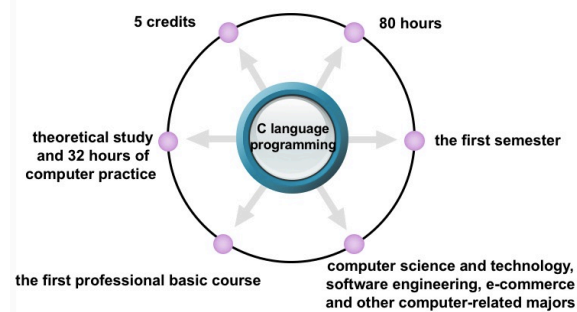


Fig. 1. Introduction of C language programming.

This course uses C language as a tool to introduce the basic knowledge and methods of computer programming to students [1]. To enable students to master the basic methods, programming skills and algorithms of programming, and to cultivate students' thinking methods and programming ability to solve and deal with practical problems by using computers [2]. Through the study of the course of C language programming, we can provide a theoretical foundation and practical ability for further study of object-oriented programming language courses, data structures and other courses [3].

II. C LANGUAGE PROGRAMMING

A. Teaching objectives

The course of C language programming is the key course of computer basic teaching. Its purpose is to introduce the basic knowledge of computer programming to students, so that students can master the basic syntax of C language, the basic methods and programming skills of programming, and cultivate students' thinking methods and basic abilities to solve and deal with practical problems by using computers [4]. The combination of computer practice enables students to learn the basic methods and skills of programming, to lay a good foundation for further training and improving students' comprehensive programming ability, and then to have a complete computer professional knowledge system, to become skilled professionals needed by enterprises [5]. Specifically, the objectives are divided into the following three categories:

1. Knowledge objective:

This course will guide learners to use C language

to program with the idea of structured programming.

- (1) Master the basic structure of the program
- (2) Master the application of array and function
- (3) Master the basic operation of pointer and file

2. Ability objective:

Make full use of the characteristics of C language, such as good structure, free and concise writing format, rich data types, diversified expression types, high efficiency of program execution and good portability, so that learners can develop rigorous programming style and habits.

(1) Master preliminary programming ideas and be familiar with basic algorithms

(2) Be able to write code independently and solve practical problems

(3) Good programming ideas and style

3. Quality objective: Get good training in the basic skills of programming, and lay a good foundation for the study of subsequent courses and future practical application.

(1) Have the quality of reading and programming

(2) Stimulate the interest and enthusiasm of learning knowledge

(3) Cultivate the spirit of teamwork

B. Knowledge structure

1. Basic concepts of C:

Algorithms, flowcharts, structured/modular programming methods and expressions, etc. The characteristics of C language; C language is concise, compact, easy to use and flexible; Rich operators, a total of 34; The data structure type is rich; Have structured control statements; The syntax restriction is not too strict, and the degree of freedom of programming is large; The C language allows direct access to physical addresses. It can carry out bit operation, realize most of the functions of assembly language, and directly operate the hardware. The generate target code has high quality, and that program execution efficiency is high; Programs written in C are more portable than those written in assembly language.

2. Three basic programming structures:

Sequential structure, selective structure, cycle structure programming: Introduce three basic program control commands and the programming methods of the corresponding structures. Master the data representation and its operation; Master the function and classification of C statement; Master the formatted input and output of data. Understand the natural development law of things and the processing flow of procedures. Use if statement to realize the selection structure; Using switch statement to realize multi-branch selection structure; Select the nesting of the structure. The for loop structure; While and do-

while loop structures; The continue statement and the break statement; Nesting of loops. Loop structure design is a structure often used in programming, through the explanation to let students understand the concept of iteration, learning is the same, need to persevere, continue to adhere to, in order to accumulate more. Lay a good foundation for further study. All kinds of programs are composed of these three structures, which are the most important.

3.Array:

Definition and initialization of one-dimensional array and two-dimensional array, and reference of array elements; Strings and character arrays. In the process of solving problems, sometimes we need to work together and exert the strength of the team in order to solve problems better. A project needs a project team to work together to complete. Students should exert their team strength in both the application and competition of innovation and entrepreneurship projects. This course focuses on the use of array to deal with batch data and matrix and other special forms of data processing.

4.Function:

Introduce the function call and parameter transfer, and use the function experiment to design the modular program. Correct calling of library functions; The definition method of the function; The type and return value of the function; Formal parameters and real parameters, parameter value transfer; Correct calling of functions, nested calling, recursive calling; Local and global variables; The storage category of the variable (automatic, static, register, External), the scope and lifetime of the variable. Program design needs modularization, function is a module with complete function, and design function requires high cohesion and low coupling. How to pass the parameters of a function is the key and difficult point of this chapter.

5.Pointer:

It introduces the unique way of using memory address to access data directly in C language, which makes the program more capable of accessing the bottom of the computer and has more powerful functions. The concepts of address and pointer variables, address operators and indirect address operators; The addresses of one-dimensional and two-dimensional arrays and strings and the definitions of pointer variables pointing to variables, arrays, strings, functions and structures; The data of the above types are referenced through pointers; Use a pointer as a function argument. A function that returns an address value; Pointers array. Pointers to pointers. Pointer is a very important concept in C language, and the underlying programming needs the participation of pointers. It is flexible, but it also

brings some dangers, so we should be extra careful about the operation of pointers, guide students to cultivate their awareness of security coding through examples of memory overflow, and pay attention to security vulnerabilities in the process of coding.

6.struct and Commons:

Use typedef to specify a new type; Structure and common body type data definition and member reference; Through the structure to form a linked list, the establishment of one-way linked list, the output, deletion and insertion of node data. Structures and communities are very important custom data types that combine several of the basic data types you learned earlier. Can be defined based on task requirements.

7.File:

File type pointer (FILE type pointer); File opening and closing (fopen, fclose); File reading and writing (application of fputc, fgetc, fputs, fgets, fread, fwrite, fprintf and fscanf functions) and file positioning (application of rewind and fseek functions). The input and output of files is a necessary operation for every programming language. You can import data from a file or permanently save data to a file.

C. Class hour arrangement

The total credit of C language programming is 5 points, and the total class hours are 80 hours, including 48 hours of theoretical study and 32 hours of computer practice. The specific arrangement of each chapter is shown in Fig. 2.

No.	Chapter	Hours	Theory	practice
1	Introduction	4	2	2
2	Sequential structure	6	4	2
3	Selective structure	10	6	4
4	Cycle structure	10	6	4
5	Array	10	6	4
6	Pointer	12	8	4
7	Function	12	8	4
8	String	6	4	2
9	struct and Commons	6	2	4
10	File	4	2	2

Fig. 2. Arrangement of Teaching time.

III. TEACHING METHODS AND MEANS

A. Teaching methods

This course is highly practical and is generally taught by means of theoretical teaching, homework, online courses and course practice. We need to combine theoretical knowledge with practical problems and strengthen the practice of practical links.

B. Teaching process

This course generally carries out the teaching link of one class hour as follows:

Firstly, the case is introduced to guide students to think about how to solve the problem through a practical problem. Followed by observation and induction, through explaining the knowledge points and solving the case problems introduced before and the corresponding expansion problems to understand the knowledge points of this lesson; Then add a case and homework to consolidate what you have learned. Finally, it makes a summary and reflection. At the same time, teachers and students need to review and answer questions after class, as shown in Fig. 3.

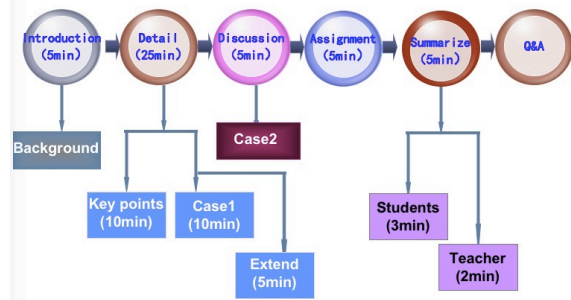


Fig. 3. Teaching process.

IV. TEACHING INNOVATION

"New engineering" corresponds to emerging industries, first of all, it refers to the specialties for emerging industries, such as artificial intelligence, intelligent manufacturing, robotics, cloud computing, etc., as well as the upgrading and transformation of traditional engineering specialties. It is a concept put forward by China under the background of new economy and new starting point in order to actively respond to a round of scientific and technological revolution and industrial transformation [6]. The new engineering course is mainly divided into two lines, which are understood from the university line and the social line. For colleges and universities, the new engineering course first refers to the new engineering specialty, such as artificial intelligence, intelligent manufacturing, robotics, cloud computing and other specialties that did not exist before. It is also an upgrading and transformation of traditional engineering majors (electronic information science and technology, construction engineering, machinery, materials, automation, traffic engineering, metallurgy, mining, system engineering, etc.). Finally, new ideas, better models and higher quality of education will be realized [7]. For society, the emphasis of new engineering is on new structure and new system. The new structure should match the industrial development, not only facing the current urgent needs, but also considering the future development [8]. The new system is to promote the organic combination of school education and social education. The new engineering course should not only serve the educational innovation of colleges and

universities, but also serve the industries that have been running in society [9].

There is a relationship of mutual dependence, mutual influence and coordinated development between disciplines and specialties: discipline construction provides knowledge system support for specialty construction and is an important basis for specialty development; Specialty construction is an important aspect of discipline construction, and specialty is the platform for discipline construction to realize the function of personnel training. The quality of personnel training depends on the level of discipline development. The cultivation of high-quality talents also promotes the development of disciplines. However, discipline is an important foundation of modern higher education and the logical starting point of the existence of modern universities. Universities are built around disciplines. It is generally accepted that the logical relationship among disciplines, specialties and personnel training is: disciplines first, then specialties, and finally personnel training. That is to say, colleges and universities generally follow the path of "setting up departments-setting up specialties-training talents" to start the work of personnel training. It is not difficult to see that the specialty construction and personnel training so far are based on discipline construction [10].

In the process of new engineering specialty construction, the above recognition and path may be broken. In the new economic environment, the construction path of new disciplines and specialties will be: "predict the future demand for talent market-transform and upgrade the existing specialties-adjust and improve the existing disciplines"; The construction path of new discipline specialty and new discipline specialty will be: "Predicting the future demand for talent market-the synchronization of discipline construction and specialty construction"; Emerging disciplines and specialties can be built on the non-entity organizational structure, not necessarily on the entity departments, in order to improve their dynamic adaptability. Only in this way can the construction of new engineering courses cultivate outstanding engineering and technological talents for the future development of industries and industries in a timely or advanced manner.

The change from "discipline-based" to "market-oriented" should become the consensus of all kinds of disciplines and professional personnel training in colleges and universities, which is not only the requirement of economic and social development for higher education, but also the responsibility and obligation of higher education to lead social progress.

The lecturer has been engaged in the teaching of the course, and has been reflecting and exploring in many years of teaching practice, mainly from the following aspects of innovative reform.

A. Innovation of teaching methods

The learning of professional courses has always focused on the lecture-based teaching in the classroom, but because of the strong ability to accept new things, strong curiosity, strong desire to explore and thirst for knowledge, the existing teaching platform cannot meet the needs of students. Therefore, lecturers try to use multiple platforms to repeatedly consolidate the course knowledge they need to master.

1. SSReader Learning

Teachers set up courses on SSReader Learning, upload courseware and other learning materials, set up task points, and interact with students and feedback the results by signing in, answering, discussing, sending messages, doing homework in class and assigning computer homework, which has achieved good results. There are the course resources, the assignments, the statistics of in-class exercises, and the list of activities.

2. Online resources

The course provides online micro-video and training system for students to learn after class, as well as C language programming (learning while practicing) training system.

3. QQ online communication

According to the fact that students like to communicate with instance communication tools, maintain good interaction with students in QQ group, Wechat and other APP, and stimulate students' enthusiasm for learning.

B. Innovation of teaching approach

Under the traditional teaching mode, knowledge is passively absorbed. How to mobilize the enthusiasm of students and take students as the center to dominate the curriculum is also a key issue in teaching. In view of the strong practicality of this course, the lecturer adopts task-driven teaching method in this course to attract students to learn actively through curriculum design or college students' competition projects. And actively participate in the project or competition, whether or not to win awards, students in the process of participation have benefited a lot, which can be fed back to the classroom teaching process, greatly mobilize the enthusiasm of students, to achieve a virtuous circle.

C. Innovation of teaching platform

The writer has a good cooperative relationship with the enterprise, and is well aware of the

importance of training the talents that the enterprise really needs, so she applied for the teaching reform project based on the Industrial Internet, hoping to further build the teaching platform of programming courses under the background of new engineering, and design the course content that really meets the actual needs of the enterprise.

As an important part of the new generation of information technology industry, Industrial Internet is not only an important part of the new infrastructure, but also the main way and means of digital transformation of the real economy. The innovation and development of Industrial Internet has become a national strategy. Industrial Internet is an industrial and application ecology formed by the all-round and deep integration of the new generation of information technology and industrial system. It mainly consists of three parts: network, platform and security. Among them, the network is the foundation, the platform is the core, and the security is the guarantee.

In terms of course content, according to the software development needs of enterprises such as industrial control and equipment management, new engineering courses such as rapid software development and other basic, intersection and professional courses can be offered. In terms of teaching methods, besides traditional classroom teaching and practical teaching, we can also use the Industrial Internet platform of enterprises to complete the task of developers, and carry out new teaching method reform.

The project is in progress, and we hope to get new inspiration and results.

REFERENCES

- [1] Zhang, X. , Qu, T. , Liu, Y. , & Yin, D. . (2020). Teaching Method Reform and Exploration of C Language Programming Training Course Based on Case. 2020 International Conference on Advanced Education, Management and Social Science (AEMSS2020).
- [2] Cui, G. H. . (2019). Exploration of teaching mode of "c language programming" for electronic information specialty in higher vocational colleges. Education Teaching Forum.
- [3] Chen, D. , Zhang, Y. D. , Wang, H. H. , Jian-Ping, J. U. , Zhang, J. , & Xiao-Lin, L. I. , et al. (2019). Study on teaching method of c language programming course based on the integration of teaching and competition. Software Guide.
- [4] Yang, Y. , Zheng, D. , Shi, W. , Gong, M. , & University, Y. . (2019). Research on innovative teaching reform of c language programming for training of new engineering talent. Computer Era.
- [5] Chun-Yan, Y. U. , & University, D. M. . (2019). Teaching reform method of c language programming

- course based on new classroom. Education Teaching Forum.
- [6] Huang, J. . (2019). The application of the checkpoints teaching method in the "c language programming" of higher vocational education. Journal of Changsha Aeronautical Vocational and Technical College.
 - [7] Nie, X. , & Liu, Q. . (2019). Bilingual course construction practice of c language programming under the background of new engineering. The Guide of Science & Education.
 - [8] Zhao, Z. . (2019). Reform and practice of teaching methods of "c language programming" course for students of mathematics. Modern Information Technology.
 - [9] Wang, M. R. . (2019). Application of mooc teaching method in the course of c language programming. Science & Technology Vision.
 - [10] Zhou, Y. J. . (2019). Investigation on ideological and political education in higher vocational computer courses:—taking c language programming as example. Education Modernization.