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Teaching Reform of Higher Vocational C Language Course Based on the Concept of TOPCARES

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Abstract: ***C language has become a basic language that computer students must master, and many colleges and universities have taken it as a professional foundation course for computer majors, however, the traditional C language course most colleges and universities use teaching methods and systems difficult to go to solve the problem of enterprise-level application of talents. Therefore, it is imperative to reform the teaching of higher vocational C language courses. This paper, guided by the TOPCARES concept, aims to explore how to promote the teaching reform of C language courses in higher vocational education from the aspects of course objectives, teaching content, teaching methods, evaluation, etc., to adapt to the needs of the development of the times and the learning requirements of students.***

Keywords: TOPCARES, C Language, Higher Vocational, Teaching Reform.

1. INTRODUCTION

With the continuous development and application of computer technology, C language has become a basic language that computer students must master, C language development engineers in the job market recruitment demand are high, but because of the lack of talents who can solve enterprise-level applications, many colleges and universities will be C language programming as a professional foundation course for computer science majors, but at present the school for the cultivation of programming talent and the demand of enterprises still exists in a certain gap, therefore, in the C language programming, there is a gap between the C language programming and the enterprise demand. However, there is still a gap between the cultivation of programming talents in schools and the demand of enterprises, so it is an urgent problem to improve students' programming application ability in C language courses. The main reasons are as follows[1]:

Third, the teaching objectives are out of touch with the social demand [2]. Some teachers lack enterprise working experience, and when designing teaching objectives, they lack market demand research, so the designed teaching objectives often lack cutting-edge, timeliness, and practicability. It can not meet the requirements of society and the market for program design talents, and students also face the anxiety of difficulty finding a job.

First, the teaching content knowledge point fault. Each chapter of the traditional textbook is relatively independent, and the lack of articulation between the chapters can easily lead to the emergence of knowledge articulation faults, imperfect knowledge frameworks, and a comprehensive ability that can not be improved.

Second, the teaching method is single. Most of the teaching methods traditionally used by most teachers are the lecture method, the teacher explains the main, heavy knowledge, and light practice, and in the digital wave of the AI era opportunity to ChatGPT as a representative of the emergence of AI products, but also to the software technology students' employment has brought a great challenge to the teachers are also facing how to build on their strengths and avoid shortcomings, avoiding the harms, and scientifically and reasonably harness artificial intelligence, so that it can better serve the teaching problem. better serve the problem of teaching[3].

Third, the examination method is single. The traditional method usually uses paper file test papers to examine the students' mastery of knowledge, the content of the investigation is more one-sided, favoring rote memorization of knowledge, ignoring the application of knowledge, teamwork, hands-on practice, comprehensive application, and other aspects of the investigation.

Given the above problems, this paper introduces the TOPCARES concept into the "Fundamentals of C Programming" course and carries out reform and practice, and reforms from the teaching objectives, teaching content, teaching methods, and teaching evaluation, to promote the reform and innovation of engineering education.

2. TOPCARES TEACHING PHILOSOPHY

TOPCARES is the indicator system of eight core competencies of TOPCARES, which is constructed by Neusoft Group based on the engineering education model of CDIO, based on inheritance and localization, combining the needs of teachers, students, and enterprises, and targeting the situation of IT majors. TOPCARES consists of eight core competencies, including Technical knowledge and reasoning, Open thinking and innovation, Personal and professional skills, Communication and teamwork, Attitude and manner, Responsibility, Ethical values, Social contribution by application practice [4]. 8 core competencies are

further divided into 32 secondary and 110 tertiary competency indicators. The 8 core competencies are further divided into 32 secondary competency indicators and 110 tertiary competency indicators, and on the basis of the tertiary indicators, the core competency indicators of professional talent training are formed by analyzing the knowledge, ability and attitude that should be mastered by different professional talents training. On the basis of the three-level indicators, through the specific analysis of the knowledge, ability and attitude that should be mastered in different specialties, the four-level indicators are formed into the core competency indicators of professional talent cultivation, so as to determine the talent cultivation objectives and cultivation specifications of different specialties [5]. It is the centralized embodiment of "learning by doing" and "project teaching", which aims to equip students with good engineering ability and profound technical basic knowledge before working [6].

3. REFORM OF C LANGUAGE COURSE TEACHING BASED ON TOPCARES

3.1 Reform of course objectives

Programming courses should pay more attention to the principle of "practical" than the traditional teaching objectives, so it should strengthen the improvement of students' application and practical operation level, the course not only focuses on the traditional knowledge and ability objectives, but also pays attention to the quality of the student's objectives and the goal of creating a society so that the students can receive the inculcation of the cultural characteristics of the workplace in the school, and develop the qualities required by the occupation. The program not only focuses on the traditional knowledge and ability goals but also emphasizes the quality goals and the goal of creating a society so that students can receive the cultural characteristics of the workplace in school and develop the qualities required by the profession[7]. Therefore, based on the three-level competency indicators of the TOPCARES teaching concept, the learning objectives to be achieved in the basic C programming course should be reformed, as shown in Table 1.

Table 1: C Programming Fundamentals Course Objectives.

Categorization of course objectives	Expected learning outcomes	Corresponding TOPCARES level 3 capacity indicators
Knowledge Objectives	Proficiency in C program composition, input, and output, data types, operators and expressions, branching structures, looping structures, modular programming of C programs, arrays, pointers and structures, and files.	1.2.1 Professional Basics 1.3.1 Specialized Knowledge
Skill Objectives	Knowledge of the basic process of writing C programs.	2.1.1 Omni-directional thinking
	Ability to write and debug C programs using a compilation environment, read and understand simple error messages and locate error points.	3.1.1 Identifying and Formulating Problems
	Ability to analyze, judge, and solve problems, and to analyze, judge, and propose solutions to common problems and solve them with C programs. Able to use ChatGPT and other AI products for learning, programming, and debugging.	2.2.1 Analyzing Problems 2.1.4 Compromise, judgment, and balance in problem solving 3.1.5 Solutions and Recommendations
	Ability to effectively communicate, interact and rationalize division of labor with team members to solve problems together.	4.1.6 Oral Presentation and Interpersonal Communication 4.3.1 Forming Effective Teams 4.3.2 Running Teamwork
Quality Objectives	Ability to digest, assimilate and re-invent what you have learned.	2.4.1 Introducing, Digesting, Absorbing and Reinventing
	To enable students to recognize and observe professional norms and to develop a proper professional attitude.	7.2.1 Identifying with professional norms
	Have good professional ethics, abide by the professional norms, assume the social responsibility of engineers, and consciously abide by the professional ethics and norms of software engineers.	6.3.1 Professional ethics, integrity and responsibility 8.5.1 Basic norms of the industry
	Ability to take the initiative to learn and access course-related materials.	5.1.2 Learning Attitude and Habits
Creating Society	Understand the functional requirements of the project, be able to master the modeling methods, techniques, and tools for project development, and continuously optimize and improve the design solutions according to the requirements.	8.6.1 Setting up system goals and requirements 8.6.3 System Modeling and Ensuring Goal Achievement 8.7.1 System Modeling and Ensuring Goal Attainment
	Accept the goals and roles of engineers as well as their social responsibilities, and realize the social responsibilities they will take on.	8.1.1 Engineer's Roles and Responsibilities
	Ability to design and implement project modules in a programming language according to the requirements, and to test and validate them.	8.8.1 Design Implementation Process 8.8.3 Software Implementation Process 8.8.5 Testing, Verification, Validation, and Certification

3.2 Teaching content reform

While TOPCARES is a "do-learning" and "project-based education and learning" [8], traditional C language courses usually follow the order of C language overview, data types, operators, expressions, sequential structures, branching structures, looping structures, arrays, functions, pointers, structures and commons, and files, functions, pointers, structures and shares, and files.

Reform will change the traditional, by-chapter, scattered knowledge points of teaching, teaching content by the project learning mode of organization, for example, in the entire teaching process, "student performance management system" project as a course

design project, as a three-tier project, but also the project is decomposed, so that the teaching content has consistency, according to the Knowledge points are divided into units, as a four-level project, according to the four-level project requires the completion of multiple tasks, to divide the subsection, the formation of the level of five-level project. Specifically, as shown in Table 2, to achieve the reorganization of knowledge points and series, so that the knowledge learned can be integrated, so that students can apply this knowledge to practical problems, and can independently complete the production of a project[9].

In addition, while having the ability to learn, we take the "Blue Bridge Cup" competition (C/c++), College Computer Proficiency Challenge (Programming), National Computer Ranking Examination Level 2 C, ACM Programming Contest (C), Computer Level 2 Certificate as an opportunity to integrate the topics into the usual courses to deeply understand the mysteries of algorithms and programs, and realize the importance of the program. Algorithms and procedures of the mystery, the realization of the integration of lessons and certificates, race to promote learning, the formation of "courses - TOPCARES - CDIO0 - jobs - competitions - certificates" cycle to promote the sustainable development of the teaching system, to enhance the student's employment weight, enhance the competitiveness of the job, and cultivate high-quality skilled personnel. In addition, it is effectively integrated into the ideological classroom in teaching, focusing on the cultivation of students' quality goals and social creation goals.

Table 2: Reconstruction of C language teaching content.

Level 3 Projects	Level 4 Projects	Level 5 Project
Student Achievement Management System	1. Programming fundamentals (overview, data types, operators, expressions, functions)	Understanding programs and programming (c language features, structure, execution process) Understanding C Programming (c language writing specifications, functions) Editing and debugging of c language program (c language development and writing process) Data operations in c language (constants, variables, operators, expressions)
	2. Menu design for grade management systems (sequential, branching, looping)	Menu item display and acceptance (input, output functions, input and output of character data) Menu selection processing (conditional judgment expressions, if, switch selection structure) Repeated use of menus (while, do-while, for, break, continue, loop nesting) Application of common algorithms (flowchart, N-S diagram, algorithm design methods: judgment, exhaustion, recursion, recursion, Monte Carlo method)
	3. Batch data processing of grades (arrays)	Entry of student grades (-dimensional array) student achievement sorting, finding (sorting: bubble sort, selective sort, insertion sort; find: sequential find, half-fold find) student achievement statistics (two-dimensional array) student performance query (character array input and output, string processing functions)
	4. Optimized processing of grades (pointers)	Handling data with pointers (pointers, pointer constants, pointer variables, pointer arithmetic) Optimizing course grades with pointers (pointers and arrays, pointer arrays, row pointers, secondary pointers) Handling multiple course grades with pointers (pointers as function arguments) String word counts (string pointers)
	5. Grade processing (structure, shared body)	Input and output of student grades (struct variables) Querying and sorting student grades (structure assignment) Aggregation of student grade information (pointers to structure day variables, arrays) Creating dynamic student information tables (dynamic storage, chained lists)
	6. Reuse of student grades (documentation)	Files and the process of manipulating them in a grade management system (concept of files, opening, and closing) Sequential reading and writing of files in a grade management system (data block reading and writing of files, formatting reading and writing, string reading and writing) Random reading and writing of files in a performance management system (file location pointers, file operation error detection)

3.3 Teaching methodology reform

The essence of the TOPCARES teaching model is based on project-based learning [10], the reform of the teaching methodology used in the project-based teaching, the implementation of the teacher-led, student-oriented education concept, the software development process throughout the entire teaching process, each of the five levels of the project consists of six parts, including the task overview, preparatory knowledge, task analysis, task implementation, the results of the exchange of results, synchronized training, with The work cycle of software development is integrated[11]. The implementation steps include: first, the teacher proposes the task for the next class in the previous class. The students are invited to go down to think and learn the preparatory knowledge needed for this task and prepare for the presentation, which can be utilized. Second, the teacher creates a scenario, asks several questions about the project before the lesson begins, and allows students to go up in groups to explain the preparatory knowledge needed to complete the task, with the teacher making appropriate corrections and additions. Third, the group role-playing, divided into a project manager, designer, programmer, tester, the teacher to inspire and guide and provide appropriate guidance, the group to explore together, determine the algorithm, draw flow charts, and work together to complete the task of programming, running and debugging, the teacher to supervise and guide and provide assistance[12]. Fourthly, for students with high completion degrees, we adopt the policy of extra points, letting them demonstrate their work on the stage, and the teacher will make comments, in addition, the group leader should score according to the performance of the members in order to improve the students' motivation of programming. Fifth, the teacher collects, organizes, and transmits better practice problems such as competitions, certificates, and after-school assignments to the Learning Pass platform. Provide platforms, such

as LeetCode, NiuKe.com, Programming by Doing, etc., to allow students to practice on their own while they are learning. All of the above steps allow students to utilize the AI products represented by ChatGPT for accessing information, programming, and debugging code[13]. The specific steps are shown in Figure 1

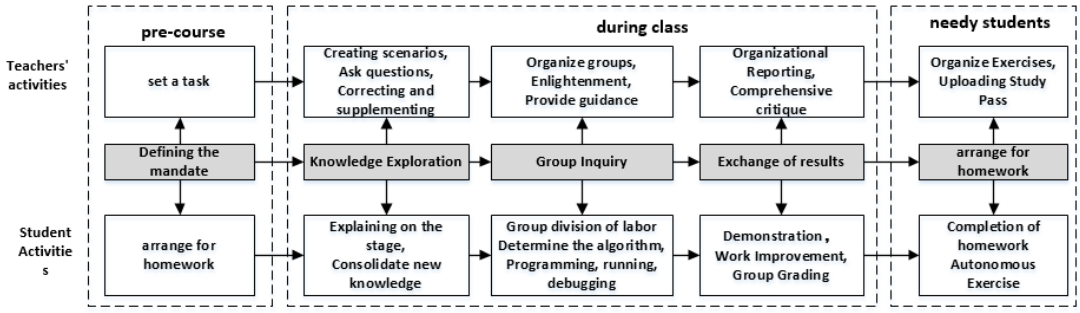

Figure 1: Project-based learning model.

3.4 Teaching Evaluation Reform

In teaching evaluation, formative assessment (60%) and summative assessment (40%) are combined. In formative assessment, reference is made to the N+2 process assessment system of Hefei College, and a variety of assessment methods are used [14], formative assessment includes attendance, performance, chapter assignments, and half-term assessment, and in the performance, competitions, certificates, and group collaboration are taken as the key extra credit items to encourage the students to get the relevant certificates and participate in competitions, and actively complete tasks in usual group activities. In the final examination, the traditional paper-based assessment method can only assess students' knowledge in a certain aspect, but neglect the comprehensive application of knowledge to solve practical problems, on the other hand, this assessment method does not satisfy the goal of project-based teaching[15], Therefore, the final assessment will be carried out by way of course design, with the teacher drawing up the topics and giving different coefficients to different topics, such as 0.7 coefficients, including student information management system and address book management system; 0.85 coefficients, including hotel management system and book supermarket cashier system; and 1.0 coefficients, including merchandise information management system and Memory Master game. Students work in groups of 4 to complete the project, and their final grade consists of the coefficient of difficulty, the amount of work completed (60%), the defense performance (20%), the standardization of documents (20%), and group cooperation (10%). The main investigation of the students' knowledge application, teamwork, communication, document writing and other abilities [16]. The specific evaluation method is shown in Table 3:

Table 3: C Language Programming Assessment and Evaluation.

Assessment Criteria	Percentage of appraisal (%)	Appraisal Details
Formative assessment (60%)	Attendance (10%)	Points: 10 points by default Leave of absence: must be signed by the teacher, no points deducted Late: 1-20 minutes after the class bell is late (-0.5 points) Early departure: 1-20 minutes before the bell is rung is considered early departure (-0.5 points) Absenteeism: being late or leaving early for more than 20 minutes is considered absenteeism (-2 points). 5 times of absenteeism will be 0 points in the regular assessment Full Attendance: plus 5 points
	Performance (15%)	Score: 0 points by default Taking the initiative to answer questions: (+1 point/time) Doing something not related to the class: (-1 point/time) Course-related competitions: (0-10 points/session) Course-related certificates: (0-10 points/certificate) Group work: (1-5 points)
	Regular Assignments (15%)	Homework completion (0-5 points) Study Pass topic responses (0-5 points) Similarity:50% of marks deducted not submitted:0 points
	Half-term project assessment (20%)	Project Name: Student Achievement Management System Similarity:50% of marks deducted not submitted:0 points
Summative assessment (40%)	Project Assessment (40%)	0.7 factor: student information management system, address book management system; 0.85 coefficient: hotel management system, book supermarket cashier system; 1.0 coefficient: merchandise information management system, memory master game. Grade = Difficulty Factor * (Workload * 50% + Defense Performance * 20% + Document Specification * 20% + Group Work * 10%) Similarity: 50% deduction of marks

4. SUMMARY

Concept of the "C Programming Fundamentals" course for the delivery of teaching reform exploration, ChatGPT, and other AI products and project-based learning combined and through the whole, under this concept of teaching practice, the results show that the student's mastery of knowledge, although not skilled enough in some of the small knowledge points, but able to comprehensively apply the knowledge gained, to complete the project production. In terms of skills, they are able to analyze and judge specific problems, and can effectively divide the work and communicate with the team to complete the tasks together. In terms of quality objectives, they are able to take the initiative to study and research, actively participate in competitions, have the ability to learn independently, and have a certain understanding of professional ethics. In the aspect of creating society, they are able to clarify the responsibilities of each member of the group, modeling, developing, and constantly debugging and improving the project.

Overall, the TOPCARES concept for higher vocational students can effectively improve the students' vocational ability, promote the integration of industry and education, and lay a solid foundation for cultivating application-oriented talents that meet the needs of enterprises. However, based on TOPCARES is by no means limited to this, it is a long-term task for both schools and teachers and still requires the joint efforts of schools, teachers, and students. Next, I will also continue to explore the future C language program courses, and further improve the reform measures in this paper.

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