

# *The Construction of Applied Courses Based on "Three level Matrix"—Taking "Fundamentals of Program Design" as an Example*

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**Abstract:** With China entering a new stage of development, it is imperative to cultivate talents with applied technology. In order to meet the needs of society, curriculum reform and teaching method reform need to be constantly carried out. At this stage, in order to implement the transformation of national ordinary undergraduate colleges and universities into application-oriented colleges and universities, many colleges and universities have embarked on the road of transformation. In order to effectively cultivate application-oriented talents, many colleges and universities need to build a number of application-oriented courses. Taking the course Fundamentals of Program Design as an example, this paper describes the process, content and method of developing applied courses in the framework of curriculum positioning, curriculum design, curriculum implementation and curriculum evaluation, and with the tool of "three-level matrix".

## **1. Current situation and background**

As China enters a new stage of development, industrial upgrading and economic restructuring are accelerating, and the demand for technical and skilled personnel in all walks of life is becoming increasingly urgent. It is imperative to cultivate application-oriented talents, and a large number of ordinary undergraduate colleges and universities are transforming into application-oriented ones.

In order to meet the needs of society, the reform of curriculum and teaching methods needs to continue. In recent years, China has strengthened the training of application-oriented talents. On January 24, 2019, the State Council issued the National Vocational Education Reform Implementation Plan, which proposed to improve the modern vocational education system that pays equal attention to academic education and training, unblock the growth channels of technical and skilled talents, and develop a professional degree postgraduate training model that is oriented by professional needs, focuses on practical ability training, and combines industry, teaching, research and application, We will promote the transformation of qualified ordinary undergraduate colleges and universities into application-oriented ones, encourage qualified ordinary colleges and universities to open applied technology majors or courses, and carry out pilot vocational education at the undergraduate level.[1]

At present, ordinary undergraduate colleges and universities in the process of application oriented transformation are in urgent need of developing a number of application oriented courses under the

guiding ideology of "conducting teaching activities in accordance with the requirements of learning and mastering real skills in real environments".

## **2. Process of applied curriculum construction**

This paper describes the process of applied curriculum construction in the framework of "curriculum positioning, curriculum design, curriculum implementation and curriculum evaluation", and with the tool of "three-level matrix".

In the process of application oriented curriculum construction, the four elements of "curriculum orientation, curriculum design, curriculum implementation and curriculum evaluation" are taken to build an application oriented curriculum system.[2] First of all, define the ranking of the curriculum in the talent training program, and determine what training objectives the curriculum needs to achieve. Then, analyze the professional needs from the professional posts related to the specialty, extract the professional knowledge and ability that need to be mastered, target them to specific courses, determine the teaching objectives of the courses based on the professional needs, divide the knowledge content of the courses into specific courses, design real projects to reorganize the courses, learn and consolidate the courses while completing the projects, Finally, complete the learning of this course. During the course implementation, "integration of production and education and dual education between schools and enterprises" is introduced into teaching, real projects are designed, real practice is organized, so that students can learn, practice and master real skills in real environments. Finally, in order to track the teaching effect in real time, it is necessary to evaluate the courses, focusing on the ability evaluation, set the course evaluation criteria, and realize the multi criteria assessment.[3]

The construction of application-oriented curriculum uses the "three-level matrix" as a tool to refine the process of application-oriented curriculum development level by level. After summarizing it, the process and method of application-oriented curriculum development will be finally displayed.

The construction of application-oriented courses should be guided by professional needs, extract professional knowledge points and ability requirements from professional needs, benchmark them to professional courses, build an application-oriented curriculum system from four aspects of curriculum positioning, curriculum design, curriculum implementation and curriculum evaluation, and gradually complete the development of application-oriented courses with the "three-level matrix" as a tool.[4] The course decomposes knowledge content into several lesson points according to professional needs, reorganizes lesson points by completing real tasks, and finally completes the learning of this course. This kind of teaching process breaks the traditional chapter teaching, introduces "integration of production and education, dual education between schools and enterprises" into teaching, strengthens the training of application ability, strengthens the closeness between the major and the industry, and improves the matching between the training objectives and the industry needs.

## **3. The content of the construction of the applied curriculum—taking the Basics of Program Design as an example**

The course "Fundamentals of Programming" is a professional basic course for computer related majors, and also an entry-level course of programming. It is usually offered in the first year of college. This course is designed not only to require students to learn a specific language, but also to learn the idea of program design, which lays the foundation for the subsequent series of courses.

This course takes C language as the carrier to enable students to have a preliminary and correct understanding of computer programming. Through course learning, students can master the basic knowledge and grammar of C language, and master the basic methods of structured programming; Master the methods and skills of reading and analyzing short programs, and master the methods and

skills of debugging simple programs; Skillfully use the top-down gradual refinement method to solve problems, finally master the programming method, develop a good programming style, and lay a good programming foundation for further learning other professional basic courses and professional courses.[5]

The construction of the application-oriented curriculum of Fundamentals of Program Design aims at cultivating application-oriented talents, takes career needs as the guidance, takes curriculum positioning, curriculum design, curriculum implementation and curriculum evaluation as the framework, and uses the "three-level matrix" as the tool.[6] The content of the curriculum construction is described below.

### 3.1. Course orientation

Before developing the applied technology curriculum, it is necessary to accurately position the curriculum. According to the talent training program of this major, we should define the training objectives, which training objectives this course needs to serve, and the position and supporting relationship of this course in the entire talent training program.

Take the course Fundamentals of Program Design as an example to build a first level matrix, define the ranking of the course in the talent training program, determine the training objectives that the course needs to achieve, and determine the supporting relationship of the course to the graduation requirements indicators. The design of the primary matrix is shown in Table 1.

Table 1: Curriculum System Matrix of Computer Application Technology (Level I Matrix)

Course name \ Graduation requirements	Graduation requirements 1			Graduation requirements 2			Graduation requirements 3			Graduation requirements 4		
	1-1	1-2	2-1	2-2	2-3	2-4	3-1	3-2	3-3	4-1	4-2	4-3
Fundamentals of Programming	★	☆	☆	★							☆	
.....												

Note: ★ is strong support; ☆ is weak support

- Graduation requirements 1-1: Systematically master the basic theory and professional knowledge of the specialty, experience systematic professional practice, understand the basic concepts, knowledge structure and typical methods of computer science, and establish core professional awareness of digitization, algorithm, modularization and hierarchy.
- Graduation requirements 1-2: Master the basic thinking methods and research methods of computer science, have good scientific literacy and strong engineering awareness or research and exploration awareness, and have the ability to comprehensively use the knowledge, methods and technologies mastered to solve complex practical problems and analyze the results.
- Graduation requirement 2-1: Analyze project or product requirements, and prepare requirements specifications and software design documents.
- Graduation requirement 2-2: Design, code and test computer software.
- Graduation requirements 4-2: Have the ability of organization and management, expression, independent work, interpersonal communication and teamwork.

### 3.2. Curriculum design

Guided by professional needs, analyze the occupations related to the profession in the society, analyze the professional needs of each profession, extract the professional knowledge points to be mastered and the ability requirements to be met from the professional needs, and target the extracted professional knowledge points and ability requirements to specific courses, which will constitute the curriculum system of the profession. For each course in the curriculum system, we need to develop it into an applied course. According to the professional knowledge points and ability requirements

corresponding to the professional needs, we need to determine the teaching objectives of the course, decompose the knowledge content of the course into several lesson points, and each teaching goal is supported by several lesson points. By designing a real task, we will reorganize the decomposed lesson points. In the process of completing the real task, Learn and consolidate each lesson point, and finally complete the learning of all knowledge contents of this course.

Taking the course Fundamentals of Program Design as an example, this paper constructs a two-level matrix, decomposes the teaching objectives of the course, and analyzes the lesson points needed to support the task of the course. We analyze the professional needs from the professional posts related to the specialty, extract the professional knowledge and ability that need to be mastered, benchmark them to specific courses, determine the teaching objectives of the course based on the professional needs, and decompose the knowledge content of the course into specific courses. The design of the secondary matrix is shown in Table 2.

Table 2: Matrix of the Course Fundamentals of Program Design (secondary matrix)

Graduation requirements	Graduation requirements 1-1		Graduation requirements 1-2	Graduation requirements 2-1	Graduation requirements 2-2			Graduation requirements 4-2
	Teaching objectives 1	Teaching objectives 2	Teaching objectives 3	Teaching objectives 4	Teaching objectives 5	Teaching objectives 6	Teaching objectives 7	Teaching objectives 8
Lesson point	Master the basic concept and structure of program design, and be able to standardize the writing of programs.	Understand the basic algorithm of programming, and establish the core professional consciousness of digitalization, modularization and stratification.	Master the basic thinking of program design and typical program design methods.	Be able to analyze the needs of the problems to be solved, and correctly design the program flow.	Master the basic knowledge and methods of programming, and be able to write programs correctly.	Be able to properly select and correctly use the program structure, independently complete the program writing, and accurately express the content you want to express with the program.	Master the method of debugging programs, and be able to test and modify programs.	Be able to communicate with others and complete the development of small systems in a team.
Task								
Task 1 Hello world	☆Lesson point 1: Basic Concepts of Program ★Lesson point 2: Basic structure of the program							
Task 2 Design personal business card					★Lesson point 3: Format Output ★Lesson point 4: Format input			
.....								
Task 13 Student transcript				★Lesson point 22: Opening and Closing Files		★Lesson point 23: Reading and Writing Files		

Note: ★ is strong support; ☆ is weak support

### 3.3. Course implementation

We reorganize the lesson points by designing real tasks, learn and consolidate the lesson points while completing the tasks, and integrate the "integration of production and education, and dual education between schools and enterprises" into the teaching process. Teachers can combine enterprises to design real teaching tasks, and design real practice links, so that students can learn, do, and master real skills in a real environment. Select effective teaching paths and methods according to the learning situation.

Take "Task 1 hello world" in the course of "Fundamentals of Programming" as an example, build a three-level matrix, and determine the measurement means and methods of knowledge points, skill points and attitude points in the course points. The design of the three-level matrix is shown in Table 3.

Table 3: Task 1 Hello world (tertiary matrix)

Teaching objectives	Teaching objectives 1 Master the basic concept and structure of program design, and be able to standardize the writing of programs.	Teaching objectives 2 Understand the basic algorithm of programming, and establish the core professional consciousness of digitalization and stratification.	Teaching objectives 3 Master the basic thinking of program design and typical program design methods.	Teaching objectives 4 Be able to analyze the needs of the problems to be solved, and correctly design the program flow.	Teaching objectives 5 Master the basic knowledge and methods of programming, and be able to write programs correctly.	Teaching objectives 6 Be able to properly select and correctly use the program structure, independently complete the program writing, and accurately express the content you want to express with the program.	Teaching objectives 7 Master the method of debugging programs, and be able to test and modify programs.	Teaching objectives 8 Be able to communicate with others and complete the development of small systems in a team.	Learning method	Didactics	Learning output and measurement standard (assessed by course point)	Teaching arrangement	
												Weeks	Credit hours
Lesson point 1: Basic concept of procedure	★K1 : Understand the basic concept of the program. ☆A1 : Attach importance to the learning of basic concepts.								self-taught	Classroom teaching	On the cloud class platform, answer questions in a limited time, and the correct rate of more than 95% is the standard.	Week 1	1
Lesson point 2 : Basic structure of the program	★K2 : Understand the basic structure of the program. ★S1: Master the requirements of writing program. ☆A2 : Careful and standard writing procedures.	☆S2: Understand the basic algorithm of programming.							Self-study, preview the learning materials assigned before the class.	Task driven teaching of relevant knowledge and operation demonstration	Complete the operation tasks assigned in the classroom, write the program in a standard way, and reach the standard when it can run normally.	Week 1	1

Note : K-knowledge ; S-skill ; A-attitude

### 3.4. Course evaluation

In the course teaching process, in order to track the teaching effect in real time, teachers need to set the course evaluation criteria. In the learning process of each task, they need to set the evaluation criteria for each course point. The evaluation should focus on the ability evaluation to achieve multiple standard based assessment.

### 4. Methods of applied curriculum construction

The construction of application-oriented courses requires a combination of various methods.

First of all, we need to conduct social research, visit enterprises and collect recruitment information, sort out and divide the existing posts in the society, rank the popularity of posts according to the demand of posts, and then analyze the hot posts, talents shortage posts, etc.

Then, according to the principles of information theory, system theory and cybernetics, we classify, extract, analyze and sort out the information collected in the previous research, and apply the processed information to practice. In the process of application oriented curriculum construction, we should formulate a personalized implementation plan, analyze the implementation through practice, adjust the implementation plan in real time, practice repeatedly, summarize and record the experience, and finally form valuable written materials.

### 5. Summary

Taking "Fundamentals of Program Design" as an example, this paper constructs a "three-level matrix" from the top to the bottom from four aspects of curriculum positioning, curriculum design, curriculum implementation and curriculum evaluation, and describes the process, content and method

of the construction of applied curriculum in detail through examples. A sound process and method of applied curriculum development can develop more and better excellent courses, help ordinary undergraduate colleges and universities to quickly transform into applied universities, and help cultivate applied talents.

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