

# Teaching design of NC turning and milling comprehensive training based on “1 + X” certificate

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**Abstract:** promoting the pilot work of 1+x certificate is an important starting point for deepening the reform of vocational education and improving the quality of personnel training. Through enterprise research, determine the teaching objectives of the NC machining training course, according to the teaching objectives, complete the overall design of the course, project design, micro ideological and political design of the course, and explore the reform of the corresponding teaching mode, including the exploration of school enterprise cooperation in education, the exploration of Hybrid Teaching of the training course, the exploration of small class teaching, etc., and complete the corresponding textbook compilation. The improvement of the academic level evaluation program has achieved certain results.

**Key words:** “1+x” certificate; CNC turning and milling synthesis; Teaching case

## Introduction

An important way for higher vocational colleges to improve the quality of personnel training is to keep pace with the times, constantly revise teaching objectives, reform teaching content and teaching mode according to the needs of students and enterprises, and improve students' academic level. Use third-party evaluation, such as participating in the 1+x certification assessment, to test the teaching level and teaching effect, and promote teaching reform.

Based on this background, with the gradual promotion of the “1 + X” certificate system, it is of certain practical significance to explore the curriculum reform of NC Technology Specialty in higher vocational colleges, especially the reform of NC machining training curriculum.

## 1. Revision of teaching objectives

Through enterprise research, we can understand the new requirements of CNC machining enterprises for skilled personnel in CNC turning and milling jobs under the background of new technologies, new jobs and new requirements in the intelligent manufacturing industry. It mainly includes the four core disciplines of post responsibility consciousness, process analysis and optimization, programming and transmission, machine tool operation and parts processing.

### 1. Post responsibility consciousness

Post responsibility consciousness refers to students' consciousness of completing or overfulfilling production tasks with high quality, high efficiency and low consumption according to the production operation plan. Including the awareness of using and maintaining the equipment according to the procedures and requirements of the equipment operation procedures, and making corresponding maintenance records; Awareness of producing and processing parts according to the requirements of drawings and process documents (process card, operation instructions, technical standards, etc.); Have the spirit of teamwork and the awareness of cooperating with others to complete production tasks according to needs.

### 2. Process analysis and optimization

Process analysis ability is the basic ability to analyze problems required by NC turning posts, which refers to the ability to solve actual production problems based on the theoretical knowledge of process design and combined with actual production; By consulting data and teamwork, we can solve practical problems in production and cultivate the ability to explore from the known to the unknown. Through the continuous optimization of the process, the awareness and ability of improving the processing quality and efficiency of parts with scientific methods and advanced technology are improved.

### 3. Programming and transmission

Programming ability includes the ability of manual programming and automatic programming. According to the established process documents, data processing and calculation of the drawings to be processed, the ability to reasonably use manual or programming software, simulation software, and the ability to complete the programming and verification. And the ability to import programs into CNC machine tools by means of manual or data communication is the necessary skills for students to go to work and the basis for job migration.

### 4. Machine operation and parts processing

Machine tool operation requires the establishment of safe operation awareness, standardized processing awareness, processing awareness according to process documents, and machine tool maintenance and maintenance awareness. Parts processing requires the establishment of the concept of quality first, taking into account production efficiency and economic benefits. Continuously improving the operation ability and reducing the auxiliary production time are the concrete embodiment of the craftsman spirit.

## 2. Teaching content design

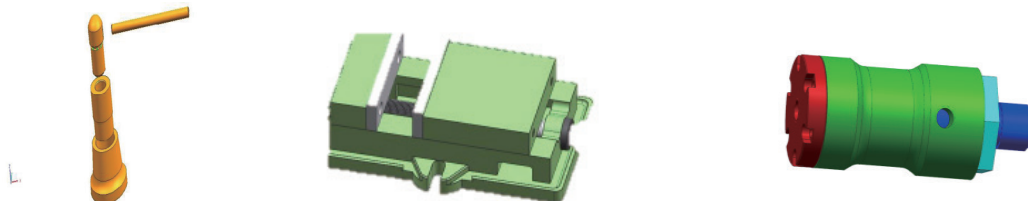
### 1. Overall design

The overall design of the course aims to cultivate the professional ability of NC machining posts, takes the design and production

of complete works as the carrier, takes the real projects with similar related elements and progressive complexity as the clue, takes the professional skill standards as the reference, and takes the self-study ability and social ability as the expansion.

## 2. Project design

According to the general requirements of NC turning and milling training, three complete projects were carefully selected: the production of screw adjusting seat (turning training project), the production of flat tongs (milling training project), and the production of single rod hydraulic cylinder (turning and milling composite training project). See Figure 1. The project content has achieved: the combination of basic and expansibility, the combination of practice and practicality, the combination of cohesion and progression, and the combination of knowledge, skills and professional attitude.



A. making of screw adjusting seat

B. making of flat tongs

C. making of single rod hydraulic cylinder

In each project, according to the production process of parts, it is divided into: drawing reading, process analysis, tool selection and cutting amount, programming and debugging processing and parts detection and analysis, reflection and rectification and secondary processing, document filing. Students digest and absorb the necessary theoretical knowledge in practical operation. In the specific tasks, the typical shaft and rod processing has three training requirements from simple to complex, the matching processing of the outer circle and inner hole has large and small, a total of five times, and there are five times before and after the milling of plate parts. It also involves the triangular thread matching and hole shaft matching, which is close to the actual production and meets the requirements of the 1+x turning and milling comprehensive certification standard and the requirements of the enterprise NC processing position.

In the learning and practice of different tasks, the skill training has certain repetition and intersection. The purpose is to make students' drawing reading ability, process analysis ability, program programming ability, machine tool operation ability, workpiece detection ability and equipment maintenance ability continuously improve in the repeated practice, realize the spiral rise, and thus cultivate students' post responsibility consciousness.

## 3. Teaching Ideological and Political Design

Integrate professional quality requirements and post responsibility consciousness into the technical skills training course, that is, integrate the ideological and political micro points, professional micro quality and skill micro behavior organically, create a "turning and milling comprehensive training" course integrating professional education and quality education, and use the strategy of "finishing touch" and "topic embedded" integration means to build a pattern of whole course education, It is a kind of comprehensive education concept that regards "cultivating morality and cultivating people" as the fundamental task of education.

### (1) Cultivate a sense of professional responsibility and mission

Through the analysis of the same turn milling composite part - single stem hydraulic cylinder end cover, whether it is processed by ordinary CNC lathe and machining center, or by turn milling composite machine tool, the different processes used, and the resulting different processing efficiency, lead the students to know the advanced CNC machine tools, and understand the localization process of high-end machine tools, Cultivate students' professional pride and professional mission.

### (2) Cultivate craftsman spirit

In the course of learning about machine tools, play the training video of students in the skills competition to feel the proficiency of their peers in operating machine tools and the regularity of the placement of items. Then, the training data of the trained students are given, including the training time and total duration every day, the number of parts processed, the schedule of weekends and holidays, etc. through comparison, we can find the gap, set up the learning goal of technical skills for students, and cultivate students' working attitude of keeping improving and the spirit of respecting work.

### (3) Cultivate students' quality consciousness

In the design of teaching project carrier, the projects are all components that can be assembled together to achieve a certain function, such as screw adjusting seat, flat tongs, single rod hydraulic cylinder, etc. in this way, the assembly size is particularly important. The unqualified size will affect the final assembly or the realization of function, and establish students' size awareness and quality awareness. At the same time, by letting students learn how to improve the processing quality and surface roughness to reduce the noise of the whole product, and how to improve the competitiveness of products in the international market, they can understand the importance of processing quality and cultivate students' quality awareness.

## 3. Teaching mode reform

### 1. Explore the teaching mode of school enterprise cooperation and cooperation with people

Through continuous communication with enterprises, including inviting enterprise personnel to negotiate with the University for many times, the curriculum standards of NC turning and milling training for different majors, such as NC technology, mold design, mechanical

manufacturing, etc., were jointly discussed and developed, and the formulation of project cases was discussed. Including:

- ① Modify the drawings of enterprise production cases, generate turning and milling cases suitable for students' learning, and realize assembly after processing.
- ② Formulate the processing technology, and design the process card and test table for students to fill in.
- ③ According to the actual situation of school machine tools, students' operation manuals, reflections, exercises, etc. are formulated.
- ④ Formulate the use scheme of theoretical teaching manual and theoretical simulation test bank.
- ⑤ Make publicity display boards and arrange workshops so that students can understand the working environment of the enterprise, the 1+x CNC turning and milling project and the assessment requirements of the project.
- ⑥ The enterprise shall organize and implement the final assessment of academic level. Through the third-party assessment, the final evaluation result is more accurate, and the problems existing in teaching can also be found.

#### 2. Explore the online and offline mixed teaching mode of 1 + X certification courses

According to the characteristics of high requirements for professional theoretical knowledge in the comprehensive textual research of 1 + X turning and milling, in order to avoid students' rote learning, online and offline mixed teaching mode is adopted, that is, teaching tasks are arranged online before class, corresponding teaching resources are provided, knowledge points involved in theoretical assessment and new processes of enterprises are integrated, and students' professional knowledge learning ability is cultivated. In the course, offline teaching is adopted to guide students to complete exercise projects, master the ability to independently complete the whole process of parts from drawings to assembly, train students' machine tool operation ability, gradually meet the assessment requirements of 1+x CNC turning and milling professional skill certificate, and break through the teaching mode of boring and repeated practice in traditional certification courses. After class, students will be guided to summarize and reflect online, and online tests will be arranged to help students find out and fill vacancies, so as to further learn the knowledge, skills and literacy involved in NC machining jobs.

#### 3. Exploring small class teaching mode

Carry out small class teaching. That is, in the teaching of some professional core courses in the same class, according to the wishes of students and the number of sets of machine tools, it is divided into 2-3 directions, such as setting multi axis processing direction, 1+x turning and milling comprehensive verification direction, CMM verification direction, five axis processing direction, turning and milling compound direction, etc. According to the results of students' choice, 2-3 directions for each class are determined. Giving students independent choices can not only mobilize students' learning enthusiasm, but also reduce the number of students per machine tool, solve the problem of insufficient number of sets of CNC machine tools relative to the number of students, increase students' practice time during class, improve students' class efficiency, and facilitate teachers' teaching management.

### 4. Preparation of loose leaf Workbook

According to the development needs of the intelligent manufacturing industry, through in-depth cooperation with enterprises, determine the list of professional abilities of CNC turning and milling positions, determine the skill operation methods and quality standards required for each professional ability according to the list, and condense the common problems and solutions in each professional ability. Prepare a loose leaf Workbook for typical problems with industry-wide and standardized operation methods and the latest industry quality standards.

### 5. Improvement of academic level evaluation

#### 1. Diagnostic incentive function of big data evaluation

The network teaching platform is used to collect various data, and big data analysis is carried out through software. The learning situation of each student is accurately analyzed, and the diagnosis results of travel alienation and personality coping strategies are obtained. Incentives are provided through excellent case display, student experience sharing and other means. Teachers focus on teaching objectives and draw targeted teaching conclusions and evaluations, which lay the foundation for gradient teaching and greatly improve the effectiveness of teaching management.

#### 2. Combination of process evaluation and summary evaluation

The academic level evaluation adopts a combination of process evaluation and summary evaluation to comprehensively and objectively evaluate students' academic status.

The process evaluation should be based on the core quality of the discipline. On the basis of examining the mastery of students' relevant knowledge and skills and application ability, it should pay attention to the development of the core quality of four disciplines, including post responsibility consciousness, process analysis and optimization, programming and transmission, machine tool operation and parts processing. The evaluation should reflect the improvement of students' abilities in all aspects during the learning process.

The summative evaluation should be based on the training requirements of students' professional ability for the first post and the learning transfer ability to adapt to the needs of career development. The case adapted from the actual processing of enterprises is used to examine the development level of students' CNC turning post ability and subject core literacy, as well as their performance in self innovation and team cooperation.

### 6. Achieve results

1+x CNC turning and milling certification can bring broader development space to the students who participate. Students' enthusiasm

to participate in 1+x CNC turning and milling certification has been effectively stimulated. In the past two years, the qualification rate of 1+x CNC turning and milling comprehensive certification of our institute has reached more than 90%. More importantly, it has stimulated students' learning enthusiasm, learned the integration of theory and practice, online and offline hybrid learning, cooperative and inquiry learning, and laid the foundation for lifelong learning to adapt to the development of science and technology and individual development. At the same time, through big data analysis, we can clearly understand our strengths and weaknesses in knowledge, skills, professional quality and other aspects, and do a good job of developing strengths and circumventing weaknesses.

## epilogue

Explore the integration of 1 + X system into CNC technology training teaching, provide teaching samples for the implementation of 1 + X certificate system in China, provide theoretical and practical cases for the construction of digital turning and milling training course and the optimization of CNC machining talent training scheme, and provide specific implementation scheme of training course construction based on 1 + X certification, which is reproducible and referential.

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