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Research on the Course of CNC Practice Based on Project Teaching in Application-Oriented College

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Abstract—With the rapid development and comprehensive application of numerical control technology, demands of excellent talents in this field are increased to a great extent. Confronted with the problems existing in the CNC practice course and cultivating high quality and excellent numerical control talents, project teaching as a new innovative teaching method for CNC practice course is presented. Then the concrete steps of project teaching are discussed. On the one hand, this method can stimulate students interest and enhance their understanding of CNC theory knowledge, on the other hand, it can improve the students practice ability. This Application practice has proven that the teaching effect is improved and get the positive reply from the student with the help of using the methodology of project teaching.

Keywords—project teaching, CNC practice, teaching reform, talent cultivation

I. INTRODUCTION

With the continuous development of science and technology, the application of numerical control technology in modem industry is more and more extensive. The numerical control technology will play an important role to the development of modem industry, especially to the underdevelopment countries[1]. A lot of manpower, material and financial resources are invested to develop numerical technology by developed countries. In china, with the development of economic, especially with the development of mechanical manufacturing industry, the demands of the numerical technology talents is increased sharply. Many colleges and universities set numerical control specialty, and cultivate many numerical control talents for the society.

Project teaching is an action-oriented teaching mode based on theory guide practice. The training target of each course is divided into many practical teaching project, the project is accomplished by the students, and the teachers guide them. So the project teaching can let the students learning theory knowledge and operating skills, it can cultivate the students systematic practice ability as well. Which is the best carrier of student-centered teaching philosophy. Thus the project teaching is widely used in colleges and universities[2,3].

Aiming at the problems exit in CNC practice education, this paper analyzes the specific requirements for teachers in project teaching firstly. Then how to apply the project teaching to CNC practice course is discussed. The assessment and evaluation system of the project teaching is provided again. And finally the practical result of project teaching is shown.

II. COURSE PROJECT TEACHING BACKGROUND

Project teaching is a student-centered activity teaching approach created by professor Katz and professor Chad. They consider learning is multi-dimensional, the progress includes information and knowledge, skills and behavior, attitudes and values, etc. and knowledge can be acquired by self-establishment of learning through practice under certain conditions[4]. The theory tells us that learning not only includes the accumulation of knowledge and improvement of learning ability, but also includes various experiences formed by students in their actions.

CNC system courses need to combine the theoretical knowledge with practical operation effectively. There are many important points in CNC principle and system, such as NC program coding, tool radius compensation, contour interpolation, etc. In order to improving the students practice ability and deepening the comprehension of CNC principle theory knowledge, one week NC practice course design is opened after the end of theory course. In curriculum design, only partial topics of CNC systems can be designed by one student because of tight schedule, so the students practice ability cannot be improved as desired. Under the guidance of strengthening practical teaching in college, school of automation revised personnel training program of NC technique, the CNC practice course is changed from one week's curriculum design to two weeks' curriculum practice. Therefore, in the new course teaching, teachers should timely change their teaching approaches and methods, so that students' theoretical basis and practical ability can be effectively combined, and can cultivate NC talents more in line with the needs of society. In these conditions, project teaching, an innovative teaching method, is applied to CNC practice teaching.

III. SPECIFIC REQUIREMENTS FOR TEACHERS

The application of the project teaching method to the CNC practice teaching puts forward higher requirements for teachers' teaching methods and teaching thinking. Teachers are no longer simply teaching students boring theoretical knowledge, but need to master flexible teaching methods, create a good environment for students to learn, and effectively improve students' learning efficiency. In the process of using

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project teaching, teachers should play more role as the guide of learning knowledge, actively guide students' learning methods and timely enlighten and solve the difficulties and problems encountered by students in learning, so as to provide students with a wide range of autonomous learning. Teachers should pay more attention to the cultivation of students' practical ability.

IV. THE IMPLEMENTATION OF PROJECT TEACHING

The course CNC practice is a key course of NC technology major, which is a professional course with deep theory and strong practice, and it plays an important role in cultivating students' professional ability in the whole teaching process. The task of project teaching is an integrated professional task, the teaching content is task guidance based on the practice, there are strict requirements for the quality of the practice and the process of completing the task. The implementation of project teaching is divided into three stages as follows:

A. *Confirm the Project Teaching Tasks*

In the practical application process, the project teaching method should firstly divide the main teaching tasks in details, and then complete different teaching tasks according to different projects. The selected project should closely relate to the NC theory and enterprise practice, so that students can carry out practical operation after theoretical study. Secondly, the topics of project teaching should notice NC professional market research and analysis, and collect useful information and data for the teaching, make the teaching effect to adapt to the needs of the development of contemporary enterprises and the demand of the talent market, improve the project teaching in the teaching of NC practice timely and effectively

The confirmation of the project is a whole system including input, process and output, as depicted in Fig. 1[5]. Input is the preparation of the project, including requirements research, research tools, students' knowledge reserve, guidance materials, guidance personnel, etc. The process is the work loop which must be completed in the project. It mainly includes four links, the design, operation, evaluation and monitoring of the project. The output is the final result of the investigation, namely the investigation report.

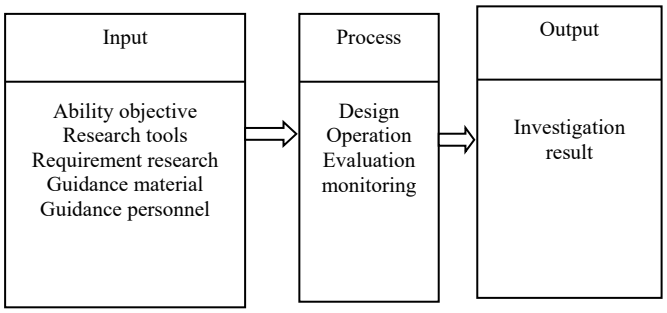

Fig. 1. Project system configuration

B. *Make the Project Task Plan*

After the tasks of the project teaching is formulated, the teachers and the students should work together to find the main method to accomplish these projects, and make a scientific and integrated project plan. Teachers in the process should be served as a guide, more ideas and actions are done by students. Teachers, according to the difficulty situation of each specific project task, choose the appropriate tasks to complete the process. The students should analyze and research the project in different point of view on the basis of the existing school teaching facilities, and then make the specific implementation plan. Through this way the students innovative thinking and operational ability get exercise, and the efficiency of students learning is improved as well.

According to the NC technique personnel training program, the practical task of the NC practice is formulated as shown in Table I.

TABLE I. PRACTICE PROJECT ITEM

No	Practice content	Practice requirement
1	Nc program coding	Know the process of NC machining program, grasp the decoding method and of NC machining procedure
2	Tool radius compensation	Understand the tool radius compensation principle, solve the connection point coordinate in different contour line(line-to-line, line-to-circle, circle-to line, circle-to circle), different stages(establishment stage, ongoing stage, and cancel stage),different types(cutting, inserting and elongating)
3	Point-by-point comparing interpolation	Grasp the point-by-point comparing interpolation principle, solve the interpolation point coordinate both the line and circle in 4 quadrants
4	Digital differential analyzer interpolation	Grasp the digital differential analyzer interpolation principle, solve the interpolation point coordinate both the line and circle in 4 quadrants
5	Time-slicing interpolation	Grasp the time-slicing interpolation principle, solve the interpolation point coordinate of line in 4quadrants, and coordinate of 3 type algorithm of circle(direct interpolator, first-order DDA approximation and second-order DDA approximation)
6	Nc system comprehensive design	Understand the working process of the numerical control system, the decoding, tool radius compensation and interpolation program are combined on the Gugao experiment table. required to realize the motor feeding motion in the two-dimensional plane according to the simple numerical control machining program(G-code program).

C. *Project Implementation*

In the project implementation phase, teachers should let students themselves to complete each step of the project, which helps to improve students' practical operation ability, and at the same time, the theoretical knowledge of students has been consolidate effectively. The combination of the theory and practice, can improve the students' learning efficiency constantly. In the process of fulfilling the project, the teacher must design the reasonable finish time, supervise the various steps and phases and provide certain guidance to students, students need record the problems appeared in each step and its solutions. As a reference when encounter the same problem in the future.

V. Evaluation of Project Teaching

The change of teaching content and teaching mode will inevitably bring about the change of assessment and evaluation method. The examination of traditional courses does not fit with the logical starting point of cultivating students. So a new assessment method should be established for the project teaching to meet the needs of current teaching. The assessment and evaluation of project teaching should integrate the assessment of ability, quality and knowledge into the completion process of the project. According to the characteristics of NC practice course and the requirements of teaching objectives, and combination the needs of professional capacity, the assessment and evaluation of the project teaching is comprised of four aspects, professional quality, learning process, comprehensive application ability, theoretical quality respectively. The assessment index is divided into three aspects, process assessment, periodic assessment and final assessment[6]. The specific assessment method is:

A. Process Assessment

The process assessment consists of six parts: information, decision, plan completion, implementation, inspection and evaluation. It mainly assesses students' attendance, classroom operation and homework. The assessment includes teacher evaluation, student self-evaluation and mutual evaluation, and team evaluation. The assessment mainly includes skill test and knowledge application ability. Total score=self-evaluation× 25%+mutual evaluation×25%+teacher evaluation×20%+team evaluation×30%. The score accounts for 30% of the semester's grade.

B. Periodic Assessment

Each project consists of several modules in project teaching, so students are assessed periodically when completing one module's project. Which mainly assesses students' practical ability and theoretical knowledge. The score accounts for 30% of the semester's grade.

C. Final Assessment

This assessment takes place before the end of the course, it mainly tests students' comprehensive utilization ability of knowledge and skills. The score is consist of oral defense of the project(50%) and the practice report(50%). The score accounts for 40% of the semester's grade.

VI. Practical result of Project Teaching

The project teaching of the CNC practice course is experimented in class NC153, it has gained remarkable effect. Firstly, the students have a clear learning goal, which inspires students' enthusiasm of learning and improves their creative-ability. Students are able to solve problems in their study independently and develop a good habit of active learning. Secondly, the students' profession ability is cultivated. Since the project comes from the enterprise or production practice, the enterprise standards is contained in the teaching content, then students also improve their professional skills in the process of learning. Thirdly, students' teamwork ability is improved. One team complete one project in project teaching. In addition to completing their own specific tasks, students should work together with team members to complete the entire project, so the team corporation ability is trained effectively. Finally, project teaching has a positive effect on teachers. The application of project teaching in the classroom makes the teaching methods innovative and professional development. In the process of project teaching application, teachers' professional knowledge level and professional skills need to be further improved. In classroom teaching, teachers should make clear their role positioning, so as to effectively improve the quality of teaching and the efficiency of students' learning. Teachers also effectively improve their knowledge literacy and professional skills in the process of project teaching

VII. Conclusions

The project teaching aims to improve the efficiency of the combination of learning theory and practical knowledge. The project teaching integrates the key programs and knowledge points involved in the practical project into the teaching and learning circle, which makes the teaching work relaxed and easy to identify and understand. This teaching model shortens the distance between students and the society, promotes the teachers to change into teaching concepts and methods, and also makes the teachers, students and teaching organizations grow in multiple directions. The application of the project teaching in the practical numerical control teaching effectively improves the efficiency of practical numerical control teaching and the learning efficiency of students. Through the combination of theory and practice, students improve their comprehensive vocational ability and lay a good foundation for students to adapt to the society in the future.

References

[1] L. F. Yang, H. Sun, "The effective use in the process of numerical control technology in mechanical manufacturing," Applied mechanic and materials, vols. 496-500 , pp. 1485-1488, 2004.

[2] X. X. Huan, C. D. Yang, "Based on the project under the applied talents training mode of teaching research," Journal of nanchang college of education, no.1, pp.45–47, Feb.2018.

[3] X. M. Chen, "Use project-based teaching to improve students' numerical control skills," Journal of panzhihua University, vol. 29, no. 2, pp. 127–128, Aprl 2012.

[4] E. Ericsson,K. A. N. Charness, P. J. Feltovich and R. R. Hoffman, "Two approaches to the study of experts' characteristics in the cambridge handbook of expertise and performance," Cambridge university press. Chapter 2, 2007.

[5] C. Y. Qian, "Project teaching:an effective way to cultivate students' practical abilities," Higher engineering education research, no. 2, pp. 187-192, 2015.

[6] J. Y. Chen,X. T. Niu, Y. Guo, "Implementation and evaluation of project teaching in numerical control speciality," Journal of beijing polytechnic college, vol. 9, no. 1, pp. 69-72, Jan.1 2010.