Exploration on Numerical Control Technology Teaching Model of Virtual Cooperative Learning Environment

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Abstract. Numerical control technology is the basis of manufacturing automation, flexible, integrated production. It has a great influence on the traditional manufacturing industry production methods and product structure. It also puts forward not only new requirements to talents cultivation but also a new challenge to moral teaching model in colleges and universities. The teaching model of the double-qualified professional teachers based on the information technology was proposed. Students can better acquire knowledge through the virtual cooperative learning environment by themselves in order to save lecture time and add practice time in class. Students also can be aware of the real workshop environments through the virtual simulation system.

Introduction

Manufacturing industry is the material foundation of national economy and social development, and it is also the concrete embodiment of a country's comprehensive national strength. In order to improve the competitiveness of manufacturing industry, advanced numerical control technology has been widely used in domestic and international manufacturing industry. It promotes the rapid development of manufacturing industry. It makes the traditional manufacturing industry change to the modern manufacturing industry. The numerical control technology has been fully applied in the manufacturing power. It can be said that the numerical control technology is an important indicator to measure whether a country is a manufacturing power [1].

With the transformation and upgrading of China's manufacturing industry, students who are qualified the knowledge and skills of CNC technology and equipment have become more and more popular in modern enterprises. However, the phenomenon of shortage of NC personnel in all over the country is very common, especially in the developed coastal areas. Some enterprises spend millions of yuan to buy CNC machine tools but few personnel can operate them. Therefore, the training of numerical control talents must be strengthened. According to the current embarrassing situation of shortage of the numerical control talents, Training mode of numerical control professional talents also needs to be reformed.

Professional Technology Education

At present, the enterprises are in urgent need of skilled personnel, what the enterprise demands are as follows.
Blue-collar Worker. Blue-collar workers are CNC operators, who are proficient in CNC machining process and process planning. And they are able to operate the machine tools and write programs. These talents are in great and urgent need. However, because there is no high demand for their professional knowledge, their wages are not high.

Gray-collar Worker. Gray-collar workers, who are engaged in the numerical control programming, the numerical control machine tools maintenance, should be familiar with CNC machining process. They also should be skilled to use CAD/CAM software, such as UG, Pro/E and so on. These personnel are popular in the mold industry and the enterprise's equipment security sector, and their salaries are higher than blue-collar workers.

Gold-collar Worker. Gold-collar workers, who have a deep understanding of the numerical control technology and master the comprehensive knowledge, are proficient in the numerical control programming, the numerical control machine tools maintenance. They are able to complete the selection of CNC system, the design of CNC machine tool electrical system, including installation, commissioning and maintenance. They also are able to independently improve the structure of the CNC machine tools. They are more suitable for the enterprise technical consultant and mechanical and electrical product designer. Their salaries are the highest.

The targets of the Specialized Secondary Schools are training blue-collar workers and gray-collar workers. The Undergraduate College should make full use of abundant and excellent teaching resources to train the gold-collar workers.

Current Problems of CNC Personnel Training
At present, the problems of CNC personnel training in the Undergraduate College are as follows.

Requirements of Development of the Enterprise. Although the curriculum has been improved in the Undergraduate College, the teaching content, especially the professional knowledge and skills, is still relatively old, and cannot keep up with the new technology of modern enterprises. Which may lead that the students cannot quickly adapt to the corresponding post.

Too Much Emphasis on Theory, Too Few Social Practice. Numerical control technology is a typical course of mechanical and electrical integration. So it is hard to learn and master this course. It involves computer control technology, software technology, mechanical processing technology, sensor detection technology and network communication technology, and so on, which is closely related to the engineering practice. At present, the teaching of numerical control technology aims to train students to master the structure and working principles of CNC machine tools. And they should learn to program. This kind of teaching mode is too much emphasis on theoretical education, but practice is less. The ability of students to solve practical problems is weak.

Lack of “Teachers, Engineers” Double-qualified Professional Teachers. Majority of colleges and universities are focus on theoretical teaching, ignoring the cultivation of students’ operating skills which leads to serious shortage of professional teachers with high education and rich practical experience. In particular, the double-qualified professional teachers, who are familiar with the production practice and able to undertake the teaching work, should be introduced.

To Improve the Teaching Methods. The teaching methods of traditional classroom make students lose interest, and gradually lose their learning motivation to the
professional course, which is not conducive to the cultivation of high skilled talents. It shows that the correct and appropriate information technology is more vivid and moving, which may make students learn efficiently in the classroom. Such as multimedia technology, which may be intuitive and illustrative for students to understand and master the intricate professional knowledge [2]. So we should make full use of advanced information technology to improve the teaching methods.

Measures of Teaching Reform of Numerical Control Technology

Reform of Textbooks

Nowadays, professional curriculum textbooks in most of the universities are edited by a few years ago. Although the basic principle of textbooks will not be changed over time, but new products, new technology update faster. The double-quality professional teachers should be organized to compile the professional textbooks of numerical control technology according to the training target and the schools’ own condition, which may be helpful for students to learn [3]. For example, numerical control technology and equipment, edited by Professor Han Jianhai from our school, is very practical for our students to learn the classical theory and corresponding skills of numerical control technology. This reform has played a very important role in the cultivation of highly skilled talents.

Because of the high cost equipment such as CNC machine tools, the majority of colleges and universities will not purchase the equipment for the needs of the teaching which is not conducive to the cultivation of students’ practical ability. School-enterprise cooperation running mode is created. On the one hand, it can reduce the difficulty in the equipment investment funds; On the other hand, the enterprise has more advanced equipment, which are helpful for students to understand the latest development of CNC technology, while there are also more operational opportunities for students. This model may be advantage for students to adapt to the enterprises.

Intensifying the Construction of Teacher Troops. In the process of training high skilled talents, the teaching staff is the key [4]. The double-quality professional teachers should be encouraged. They may not only impart theoretical knowledge to students, but also train them to study on numerical control machining technology. Only in this way the combination of teaching and practice can be actualized. The imperative effort is that the corresponding measures should be taken to provide incentives for teachers to achieve the results in practice.

Application of Information Technology in Numerical Control Teaching.
Numerical control technology is an applied discipline. Because the combination of experiment and teaching is difficult to achieve good coordination, the teaching effect is not ideal. With the development of information and communication technology, it would be useful to improve the traditional teaching model.

Application of Virtual Simulation System. Simulation is to study an existing or design system through the experiment of the system model. Computer simulation is the process of using the computer to make use of the system model to carry out experimental research on the actual system. By means of computer software and hardware function, virtual CNC machining simulation technology may realize the whole process of CNC machining from design drawings to dynamic cutting demonstration through the specific numerical control system [5].
Because the numerical control programming is boring and easy to make mistakes, students may have no interest to learn this course. Simulation teaching model is introduced to convert the complexity of the knowledge to the visual image, which can be presented through multimedia and network technology so as to effectively improve the teaching quality of CNC programming. Through the simulation of the numerical control programming, the abstract knowledge will be turned into teaching video, which is vivid and easy to learn. And it will greatly stimulate their interest.

**Virtual Cooperative Learning Environment.** In the virtual cooperative learning mode, students’ learning is not dependent on the teacher's teaching and textbooks. The digital platforms and digital resources are utilized for students’ autonomous Learning [6]. The teaching model of discussion and cooperative learning are built between teachers and students. The methods of multimedia, hypertext, and friendly interaction can be chosen to solve problems in the virtual laboratory, where students can do some laboratory work with their own hands to verify the correctness of the theory. Which may enhance the students’ sense of achievement through the virtual cooperative learning mode; students may have a good understanding of scientific theory and practical activities. The ability of coordination, communication and comprehensive can be trained and promoted. It also can cultivate students’ professional quality and scientific and realistic spirit. The virtual cooperative learning environment is shown in Fig. 1.

![Virtual simulation system diagram](image)

**Figure 1.** The virtual cooperative learning environment.

**Summary**

The training of high skilled numerical control talents is the demand of the enterprise's modernization development. It is also the advance direction of the numerical control technology specialty in colleges and universities. The teaching reform of numerical control technology course should have clear objectives. Taking the student's ability training as the main line, the practical teaching link should be strengthened. Although our school in the teaching process of CNC technique has made certain progress, we should do better. We will make every effort to cultivate innovative talents that the motherland needs.
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