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Research on the Integrated Teaching Mode of Numerical Control Machine tool and Programming Theory——Taking hole Machining Fixed Cycle as an Example

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Abstract: At present, the teaching mode of CNC machine tools and programming technology generally adopts face-to-face teaching. In reality, CNC machine tools have high processing noise and auxiliary air source noise. Therefore, it is impossible to use actual CNC machine tools for on-site teaching. Moreover, it poses certain risks for beginners, and the practical teaching effect is poor. Many CNC machining instructions possess the characteristics of multiple steps and easy confusion of work steps. In traditional teaching, students usually to operate CNC machine tools after theoretical classes. It is easily to cause tool breakage, chipping, collision and other damages due to students' unfamiliarity. In addition, it can also cause dangerous accidents in severe cases. This article constructs a practical application-oriented integrated talent cultivation model that combines theoretical teaching, simulation reproduction, and practical processing. It will be establish a student-centered seamless teaching model that covers classroom theory, simulation training, and practical application processing. And this teaching model will be achieve students' initial understanding, familiarity, and effective use.

Keywords: Numerical Control Machine Tool and Programming;Integrated teaching mode of Theory-Virtual-Practice;Talent Training

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1. Introduction

In 2017, the "Manufacturing Talent Development Planning Guidelines" jointly released by the Ministry of Education, the Ministry of Human Resources and Social Security, and which predicted that, the talent gap in the field of high-end CNC machine tools will reach 4.5 million in 2025[1]. As an important component of intelligent manufacturing, CNC machine tools talents are still in short supply in the current context of intelligent manufacturing. Therefore, the cultivation of applied talents has become the primary task of local universities[2]. Applied talents refer to a specialized type of talent that applies professional knowledge and skills to the professional social practice they engage in. They are skilled in mastering the basic knowledge and skills of social production or social activities on the front line, and mainly engage in technical or professional talents engaged in frontline production.

At present, the cultivation of engineering technology applied talents in local universities is only limited to the direct transition from classroom to practice[3]. However, students are limited to theoretical cognition and imagination during this process,, making it difficult to grasp the true meaning of actual production in a short period of time. This leads to local engineering graduates entering

enterprises requiring a long period of internship adaptation, leading relevant employers to unilaterally believe that the quality of talent cultivation in universities is poor.

This teaching mode takes the holes machining of CNC machine tools and programming courses as an example to construct a practical application oriented theoretical teaching, simulation reproduction and practical processing three integrated application oriented talent training mode. This establishes a student-centered, seamless teaching mode from classroom theory, simulation training to practical application processing, achieving students' initial understanding, familiarity, and good use.

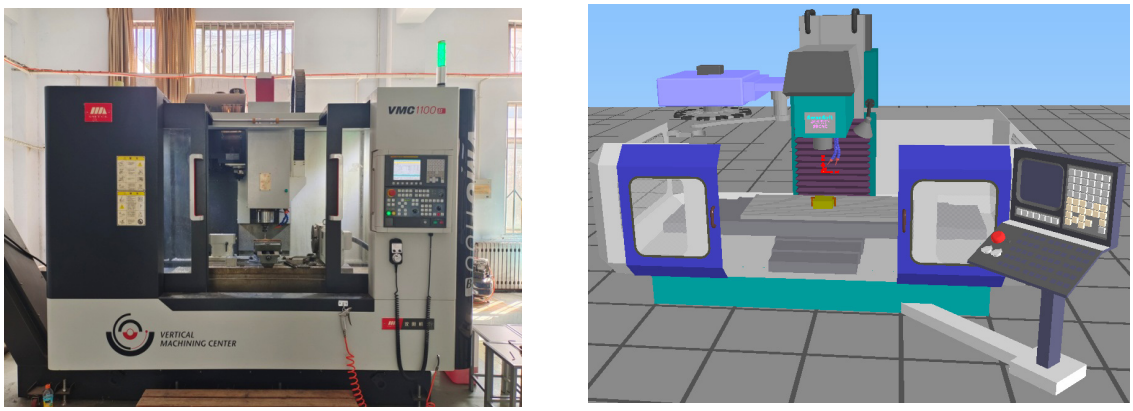
2. Taking the fixed cycle of hole processing as an example to construct an integrated teaching model of theory, virtual and reality

2.1 Characteristics of fixed cycles in hole processing

The fixed cycle instructions for hole machining in CNC machine tools and programming courses have the characteristics of multiple steps and easy confusion of work steps. The actual hole machining of CNC machine tools can easily cause damage such as bending and breaking of drill bits, and in severe cases, it can also cause dangerous accidents. The aerodynamic noise and machining noise in on-site practical teaching are high, and the teaching effect is poor, becoming a serious obstacle in the process of cultivating applied talents[4].

2.2 Integrated teaching strategy of theory, virtual and reality

This course first adopts theoretical teaching to enable students to gain a preliminary understanding of relevant professional theoretical knowledge. Secondly, it achieves familiarity with the knowledge learned through virtual digital machine tool machining (Figure 1). Finally, it achieves practical results through CNC machine tool machining.



（a）CNC machine tool　　（b）Virtual CNC machine tool

Figure 1. Practical and virtual machine tool

2.3 Implementation of the integration of theory, virtually and reality

Using fixed cycle instructions for hole machining to process the part pattern shown in Figure 2.

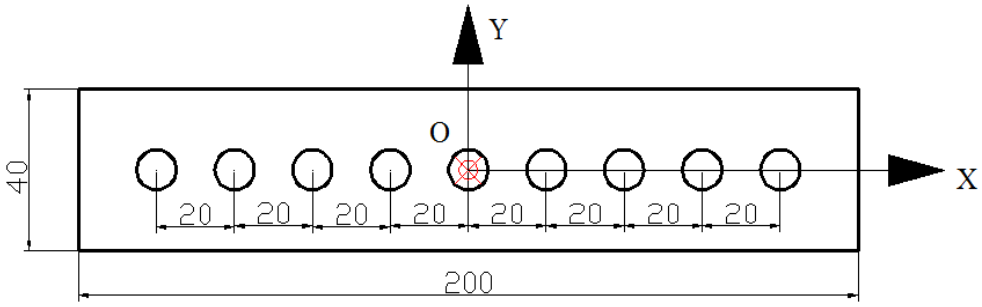


Figure 2. Rectangular array hole machining parts

Present the meaning of each instruction code and the differences between similar instructions in the form of a table. Write processing programs in the form of a table and provide annotations (as shown in Table 1), which is convenient for students to self-study. It also solves the problem of students being distracted or unable to keep up with the teaching progress, resulting in missed listening and misjudgment, and it is more convenient for students to review after class. This teaching mode can meet the needs of students with a certain foundation in the curriculum to fully self-study, especially suitable for the lack of knowledge caused by some students being unable to return to school during the epidemic situation.

3. Specific results of the integrated teaching model of theory, virtual and reality

The teaching effect achieved in this case can be achieved through three main lines, student-centered, engineering application oriented, and problem oriented.

3.1 Student-centered

This course presents the meanings of each instruction code and the differences of similar instructions in the form of a table. The processing program is written in the form of a table and annotations are provided to facilitate students' self-learning. It also solves the problem of missed listening and misjudgment caused by students being distracted or unable to keep up with the rhythm in class from a certain perspective, making it more convenient for students to review after class. This teaching mode can meet the needs of students with a certain foundation in the curriculum to fully self-study, especially suitable for the lack of knowledge caused by some students being unable to return to school during the epidemic situation.

This case first adopts theoretical teaching to enable students to achieve initial understanding, then achieves familiarity through virtual digital processing, and finally achieves effective utilization through CNC machine tool processing.

3.2 Engineering application oriented

To enable students to establish an engineering concept, this teaching mode select typical parts processing in the field of mechanical engineering as the object.

To increase the overall knowledge level progression of student, new knowledge points was introduced by the shortcomings in the processing of mechanical components in the field of mechanical engineering.

3.3 Problem oriented

The fixed cycle instructions in hole machining has many characteristics, including multiple steps and easy confusion. To make students familiar with fixed cycle instructions in hole machining and preventing accidents such as tool collision and drill bit breakage in actual CNC machining, this teaching mode demonstrates the movement trajectory of fixed cycle cutting tools in hole machining through theoretical explanation and virtual digital simulation.

Traditional teaching mode has poor teaching effectiveness due to the problems of slow acceptance by students, the possibility of safety accidents caused by actual CNC machining, as well as the high aerodynamic noise and machining noise in on-site practical teaching. This teaching mode case will simulate and output relevant programs in a virtual environment after theoretical teaching, so that students can achieve familiarity from beginners, thereby reducing errors in actual CNC machining, preventing the occurrence of safety accidents, achieving the effective use of knowledge points, and realizing seamless integration from classroom to engineering practice or from school to enterprise.

4. Conclusions

This article takes the fixed cycle of hole processing as an example. To construct an integrated teaching mode of theory, virtual reality, and practical knowledge, this article used modern information technology, and student-centered, engineering application oriented, practical problem-oriented based on the many problems that exhibit in the cultivation of applied talents. This teaching mode can achieve the initial understanding, familiarity, and effective use of professional knowledge, as well as seamless integration of students from classroom to engineering practice, and from school to enterprise. This achievement effectively promotes the high-quality cultivation of applied talents in local universities, enabling students to comprehensively understand and master the main workflow, principles, and key technologies of CNC machine tools, programming and processing. In addition, which can further enhance their professional interest and ability to integrate theory with practice, and consolidate their professional theoretical foundation knowledge or enhance their practical ability, innovation ability, and international competitiveness. This achievement has high promotion and application value in the process of cultivating applied talents in local undergraduate universities.

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