

Design and Practical Exploration of Curriculum Ideological and Political Education: Taking the Course “CNC Machining Technology and Programming” as an Example

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Abstract: Aiming at the course “CNC Machining Technology and Programming”, this paper conducts teaching reform and exploration based on ideological and political elements and virtual simulation practice. First, it analyzes the importance of introducing curriculum ideological and political education into this course. Second, it studies the organic integration of various ideological and political elements with professional knowledge points of CNC machining. Then, it designs teaching models including blended teaching, diverse teaching methods, innovative teaching content, and multi-dimensional curriculum resources based on curriculum ideological and political education. Furthermore, it continuously improves the practical simulation cases of integrating curriculum, ideological and political education with professional knowledge in each phase. Finally, it summarizes the course implementation effects.

Keywords: CNC machining technology and programming; Ideological and political elements; Virtual simulation practice

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1. The importance of implementing curriculum, ideological and political education

Curriculum ideological and political education is a beneficial exploration to realize “full-process education and all-round education”^[1]. Exploring ideological and political elements is a key link to promote the teaching practice of curriculum ideological and political education and deepen the integration of knowledge implementation and value guidance. In recent years, many scholars have conducted in-depth research on the exploration of ideological and political elements, providing rich theoretical and practical guidance for promoting the construction of curriculum ideological and political education. Document^[2] points out that ideological and political elements should be explored from aspects such as innovation-driven development, coordinated development, green development, and open development. Document^[3] combines the characteristics of mechanical majors to construct a four-level moral education element library covering spirit and feelings, technology and innovation,

history and culture, and mechanical artistic beauty. Document^[4] explores the integration of ideological and political elements into courses, forming a “trinity” education model involving schools, society, and families. Document^[5] constructs a curriculum ideological and political system under the background of “new normal education”. Document^[6] explores curriculum, ideological and political education in CNC manual programming under the blended teaching model. Documents^[7–9] explore ideological and political education in CNC training courses. Document^[10] discusses the production method of micro-courses integrating “curriculum ideological and political” elements. Documents^[11–14] conduct detailed exploration and research on ideological and political elements in CNC machining and CNC technology-related courses. The integration of ideological and political elements into classrooms is an important way to implement fostering virtue through education, all-round education, and correctly guide young people. It not only ensures that students learn professional knowledge but also cultivates comprehensive developers who can contribute to social progress. Therefore, as an important professional education course for mechanical majors, “CNC Machining Technology and Programming” is not only responsible for cultivating professionals with excellent skills for China’s intelligent manufacturing but also for nurturing individuals who can drive social development.

2. Ideological and political content of the course “CNC Machining Technology and Programming”

The course “CNC Machining Technology and Programming” is a professional course closely linking theory and practice for manufacturing majors. It mainly studies technical issues in the machining process and applied technologies of CNC programming, featuring a high integration of theoretical knowledge and practical skills^[15]. The course aims to improve students’ professional skills and quality, focusing on cultivating their comprehensive practical abilities. It takes the establishment of a knowledge system, the cultivation of quality, and the improvement of practical operation ability as the core, comprehensively cultivating students’ abilities to pursue truth, understand reality, and distinguish principles. The course covers a wide range of content and contains abundant exploitable ideological and political elements. The organic integration of professional knowledge and ideological and political elements is an urgent problem to be solved.

The course is generally taught to junior undergraduate students majoring in mechanical manufacturing. It plays an important enlightening role in helping young students who are about to enter society establish correct outlooks on life and values. In the teaching process, adhering to the teaching concept of fostering virtue through education, we organically combine professional knowledge with curriculum, ideological and political education. In the teaching of professional knowledge, we focus on ideals and beliefs, patriotic feelings, moral cultivation, knowledge breadth, craftsmanship spirit, and comprehensive quality, naturally integrating ideological and political elements, and integrating ideological and political work into the entire process of education and teaching. This stimulates students’ patriotic awareness and sense of responsibility, guides them to establish correct outlooks on life and values, and realizes the equal emphasis on teaching and education. The overall design of ideological and political elements in the course “CNC Machining Technology and Programming” is shown in **Figure 1**. Similar ideological and political elements can not only be applied to this course but also to other related courses in mechanical majors.

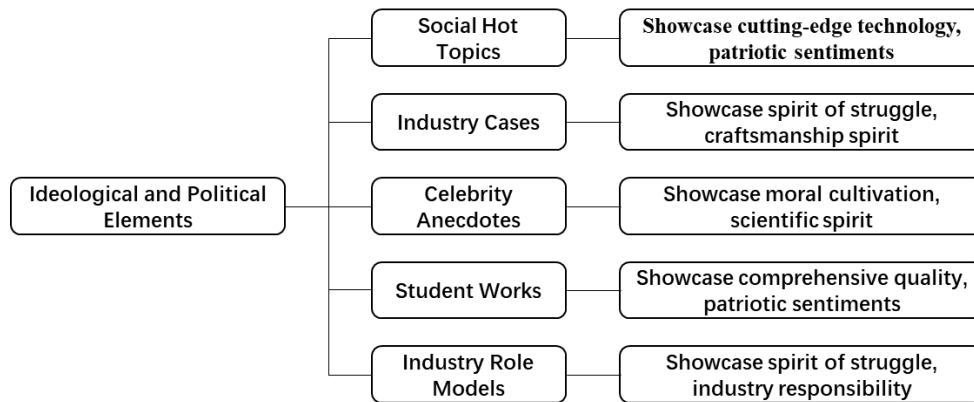


Figure 1. Ideological and political elements of the course “CNC Machining Technology and Programming.”

Targeting junior undergraduate students majoring in mechanical manufacturing, this paper designs various ways to integrate ideological and political elements with course knowledge points, enabling students to receive ideological and political education while learning professional knowledge. The specific implementation methods are as follows.

2.1. Introduction of social hot topics

The course “CNC Machining Technology and Programming” includes content such as G-code programming, cavity machining technology and programming, and hole machining technology and programming. This knowledge is closely related to various machines and CNC-machined parts in the manufacturing industry. Introducing professional knowledge through social hot topics can not only help students care about current affairs but also show the strength of the motherland and stimulate their patriotic enthusiasm. For example, when explaining G-code programming, we introduce the hot news of the successful first flight of the Long March 5B carrier rocket, and link the 3D printer launched with it to the knowledge being explained. This not only increases students’ learning interest but also shows the vigorous development of China’s aerospace industry, enriches their knowledge, and stimulates their patriotic feelings.

2.2. Introduction of industry cases

The course “CNC Machining Technology and Programming” is closely linked to engineering practice, and knowledge related to CNC machining is used in various industries related to manufacturing. Introducing relevant industry cases into the course can not only arouse students’ interest in listening but also convey the spirit of self-improvement, unrelenting struggle, and rigorous research craftsmanship. For example, when explaining thread machining on CNC lathes, we introduce the case of Peng Fangzhao, a post-90s engineer from Foshan. After more than 4 years of research, he developed a 7-axis 5-linkage machine tool to process high-precision screws for dental implants, filling the gap in the clinical application of domestic dental implants. This allows students to understand the wide application fields and technical frontiers of screws, and guides them to experience the spirit of struggle and craftsmanship.

2.3. Introduction of celebrity anecdotes

The course “CNC Machining Technology and Programming” includes basic knowledge, such as an overview of CNC programming and CNC machine tool coordinate systems. Behind this knowledge are stories of some

scientists, which can not only create a relaxed learning atmosphere but also enrich students' knowledge, convey the scientists' persistent exploration spirit and perseverance, and guide students to establish a scientific spirit of thinking and a tenacious will to overcome difficulties. For example, when explaining the coordinate system on CNC machine tools, we introduce the story of the great mathematician and philosopher Descartes discovering the coordinate system. He pondered hard even when he was ill in bed, which not only eliminates students' sense of strangeness in learning machine tool coordinate systems but also attracts their attention and guides them to develop a scientific spirit of thinking.

2.4. Introduction of student works

To better reflect the status of “student-centered” and “teacher-led” and cultivate students' comprehensive abilities, for content such as coordinate transformation function instructions, process analysis and programming of typical parts on CNC lathes, and process analysis and programming of typical parts in CNC milling, we introduce students' design works, which not only enhance their comprehensive quality but also cultivate their innovative thinking. For example, when explaining coordinate transformation function instructions, we start by displaying students' design works of anti-epidemic line diagrams using basic G-codes, and select works related to scaling, mirroring, and rotation to introduce the teaching theme. This not only cultivates students' design ability and innovative thinking but also enhances their patriotic feelings.

2.5. Introduction of industry models

Combining national craftsmen and industry models related to the knowledge points of CNC machining technology and programming with relevant course knowledge points, we use the deeds of typical figures to show the contemporary craftsmanship spirit, set examples for students, and thus cultivate their excellent qualities of fearlessness of difficulties, striving for progress, and pursuing excellence, guiding them to establish correct worldviews, outlooks on life, and values. For example, when explaining the machining technology and programming of holes, we introduce Yang Feng, a national craftsman specializing in drilling key components of aero-engines. This not only allows students to understand the application fields and importance of holes but also shows the contemporary craftsmanship spirit through the craftsman's experience of forgetting food and sleep and diligent research. At the same time, the application of holes in cutting-edge technology fields enhances students' interest in listening and national pride.

3. Teaching design of “CNC Machining Technology and Programming” based on curriculum ideological and political education

On the basis of introducing ideological and political elements, this course also conducts some explorations in teaching models, teaching methods, teaching content, and teaching resources.

3.1. Blended teaching model

Adopting an online-offline blended teaching model of “MOOC resources + Rain Classroom”, combining the characteristics of the course, following the guiding ideology of teachers leading the learning process and students participating as the main body, we use the method of “MOOC learning + Rain Classroom testing + group reporting” to guide learners' learning from shallow to deep towards in-depth learning.

3.2. Diverse teaching methods

In addition to traditional classroom teaching, this course adopts task-driven teaching, case-based teaching, Yulong CNC software simulation, and other methods to cultivate students' abilities to think, analyze, and solve problems; it guides and encourages students to acquire knowledge through practice, and increases teaching links such as discussion classes, Q&A, and questioning.

3.3. Innovative teaching content

Within the scope of the teaching syllabus, we introduce students' design works, comprehensive training physical works, and graduation design processing works as programming objects, analyze the CNC machining process of these parts, and compile programs to cultivate students' thinking of applying what they have learned. For example, when explaining the machining technology and programming of machining centers, we introduce students' comprehensive training parts as programming objects, which not only enhances students' interest but also lays the foundation for subsequent comprehensive training courses. At the same time, guiding students' learning for the purpose of application can improve their engineering awareness and guide them to pay attention to the connection between design and processing.

3.4. Multi-dimensional curriculum resources

Enrich the course with resources such as traditional textbooks, China University MOOCs, professional websites, relevant WeChat public accounts, and typical student assignments. For example, match the knowledge points of each chapter with resources on China University MOOCs and send them to students for preview before class; push WeChat public accounts such as CNC China Forum and Frontiers of Mechanical Automation to expand students' knowledge.

4. Practical simulation cases of integrating curriculum, ideological and political education with professional knowledge

Combining the current situation of national prosperity and patriotic education, we assign virtual simulation practice course designs of basic G-codes. The topics are updated according to current events each phase. The assignment content is gradually improved from design drawings at the beginning to adding editing programs and Yulong simulation video display later. The continuously improved assignment settings not only allow students to apply what they have learned but also stimulate their patriotic feelings and national pride.

4.1. Phase 1: Simulation practice course design

Design a line diagram showing national prosperity and strength using straight lines and arcs, and simulate it in Yulong simulation software. This not only tests students' mastery of basic programming instructions but also stimulates their sense of pride in the motherland's strength.

4.2. Phase 2: Simulation practice course design

Design a line diagram showing patriotic education using straight lines and arcs, and simulate it in Yulong simulation software. This not only tests students' mastery of professional knowledge but also stimulates their patriotic feelings.

4.3. Phase 3: Simulation practice course design

Design line diagrams that can show Guangdong characteristics, regional characteristics, aerospace, Winter Olympics, etc., using straight lines and arcs, and simulate them in Yulong simulation software. The open topic design allows students to use their imagination, and while mastering professional knowledge, guides them to care about national affairs, regional characteristics, cutting-edge technology, etc.

The continuously improved practical simulation design not only introduces ideological and political elements in an open way to guide students' innovation but also enables students to deeply master key knowledge points such as basic G-code programming, CNC program structure, and the application of Yulong simulation software, experience the fun of learning, and enhance knowledge visualization. Taking the second phase of patriotic education design as an example (**Figure 2**), the corresponding programs submitted by students are not only grammatically correct but also have detailed explanations for each program segment, truly understanding and mastering the essence of CNC programming.

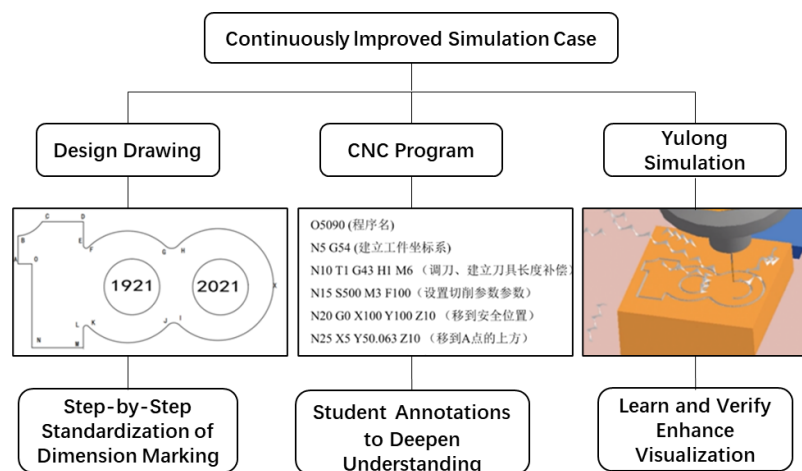


Figure 2. Virtual practice simulation design assignment integrating curriculum, ideological and political education with professional knowledge.

5. Conclusion

Integrating ideological and political elements into the online-offline blended classroom of “CNC Machining Technology and Programming” is an important way to realize full-process education and all-round education. Introducing professional knowledge through social hot topics can guide students to care about current affairs, enhance national self-confidence, and stimulate patriotic enthusiasm; through industry cases and industry models, it conveys to students the spirit of unrelenting struggle and rigorous research craftsmanship; through celebrity anecdotes, it encourages students to establish a scientific spirit of diligent thinking and daring to innovate; through student works, it trains students' comprehensive quality and innovative thinking. Ultimately, it promotes intelligent manufacturing, realizes China's transformation from a manufacturing power to a manufacturing powerhouse, and cultivates versatile talents with both moral integrity and professional competence in the new era.

In the practice of curriculum ideological and political education, integrating knowledge points in CNC machining technology and programming with ideological and political elements through various entry points in terms of teaching models, teaching methods, teaching content, and teaching resources not only enables students

to learn professional knowledge but also receives moral education, enlivens the classroom and increases interest, enriches teaching links and improves teaching effects.

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