Teaching Research and Exploration of "Stamping Forming Technology and Molding Design" Course under the Background of New Engineering

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Abstract. Based on the needs of the construction of new engineering requirement, this paper analyzes the important issues to be solved in the course and teaching reform of "Stamping Forming Technology and Molding Design," and proposes a series of teaching reform measures such as optimizing teaching design, changing teaching methods, exploring teaching strategies, and improving the assessment system. Teaching practice has been carried out, achieving good teaching effects, and realizing the dual-line sublimation of knowledge and ideological and political education.

Keywords: molding design; teaching research; teaching practice

1 Introduction

The development of new engineering disciplines stands as a pivotal initiative in advancing engineering reform and is a crucial component of higher education reform in the modern era[1]. The molding industry is integral to a variety of sectors including automotive, electronics, IT, household appliances, packaging, mechanical and electrical machinery, rail transportation, medical devices, construction materials, and consumer goods. It serves as a cornerstone in the production of essential components that drive national development, with molds permeating every aspect of our lives, production processes, infrastructure, aerospace, and defense.Stamping molds, a critical subset of the molding industry, constitute approximately 40% of the sector and find extensive use in automotive, household appliances, agricultural machinery, and construction machinery industries. Consequently, there exists a pressing demand for skilled professionals in stamping technology.

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The course "Stamping Forming Technology and Molding Design" is tailored to cultivate talents in stamping technology. It provides a systematic overview of the deformation process, deformation characteristics, quality control, typical mold structures, and design methods of stamping technology[2]. The course aims to enhance students' capacity to analyze and resolve engineering and technical challenges in stamping production through the application of stamping forming theory and technology.Through comprehensive study from stamping, bending, deep drawing, forming technology and mold design, students will develop the skills necessary to design molds for stamping parts across various processes. They will also acquire proficiency in calculating and drafting mold drawings, fostering a culture of craftsmanship and exploration. This approach instills in students a sense of duty and mission to pursue knowledge. Ultimately, it will inspires students to serve their goal with pride and responsibility.

2 Key Issues to be Addressed in Curriculum and Teaching Reform

(1)Content: The teaching content is largely uniform, overly simplistic, and disconnected from real-world applications.

(2)Methodology: Traditional teaching methods predominantly rely on teacher-centered, didactic approac-hes, where teachers deliver lectures and students passively listen. This approach diminishes students' initiative and interest in learning, leading to a decline in engagement over time.

(3)Effectiveness: Students' lack of initiative and interest in learning, combined with the monotony of classroom instruction, contributes to poor teaching outcomes and subpar academic performance.

(4)Ideological and Political Education: The focus of the curriculum is primarily on imparting knowledge, with insufficient emphasis on ideological and political education.

3 Overall Teaching Design

Prior to the course, students are provided with pre-reading materials, videos, and resources through the SuperStar Learning Platform to familiarize themselves with relevant knowledge and operational methods.In the classroom, the SuperStar Learning Platform is used for attendance, surveys, bullet screen interactions, and quizzes to understand students ’pre-reading and learning progress. Interactive activities with students are incorporated during breaks, enabling functions such as uploading assignments and monitoring student progress, allowing real-time monitoring of student learning progress and feedback.

The course materials used by teachers in the classroom are uploaded to the learning platform for students to review after class.The final group project is a comprehensive application of course knowledge, enhancing teamwork and improving students, problem-solving abilities.

3.1 Benchmarking Graduation Requirements, Analyzing Student Situations, and Defining Course Objectives

This course is offered in the fifth semester, following related courses such as "Mechanical Engineering Materials," "Mechanical Drawing," and "Interchangeability and Technical Measurement." Through previous courses, students are able to design and draw simple part drawings, develop simple processing technologies for two parts, and possess a certain knowledge of engineering materials and heat treatment.

Many students in the materials forming major are introverted and dislike expression, which, while keeping the classroom quiet, can also be an obstacle to interactive discussion-based teaching.Stamping die design is based on the foundation of stamping forming knowledge, focusing on stamping molds, stamping materials, and stamping equipment. It explains basic knowledge of several common stamping processes such as blanking, bending, and deep drawing, as well as mold design process, design and calculation of mold design, and selection of overall mold structure and components. This course is highly practical and comprehensive, requiring students to have a broad knowledge base and mastery of foundational course knowledge. According to the engineering education certification standards, 19 requirements supporting the achievement of the professional training objectives have been determined. Based on the support of this course for the graduation requirements, the course objectives are determined as follows.

Knowledge Objectives: Develop a knowledge system on stamping forming, sheet metal forming rules, and their relationship with stamping technology and die design; acquire design methods for stamping process and stamping mold.

Skill Objectives: Possess the ability to analyze and propose reasonable solutions to complex engineering problems in the field of stamping engineering according to the structure, quality, and production guidelines of stamping parts; design stamping processes and stamping molds.

Qualitative Objectives: Improve students 'ability to correctly identify, analyze, and solve problems; strengthen students 'engineering ethics education, cultivate students ' spirit of craftsmanship and exploration, and their sense of responsibility and mission to pursue the unknown, seek truth, and scale scientific heights, inspire students 'patriotism and mission to serve their country with science and technology.

3.2 Clarifying Teaching Ideas and Reorganizing Teaching Content

Previously, the knowledge structure introduced basic stamping knowledge first, followed by separate introductions to basic stamping processes such as blanking, bending, and deep drawing[3]. However, following this teaching sequence, it was found that students 'performance in subsequent course and graduation design processes was unsatisfactory, as they could not effectively integrate and apply the knowledge learned. Particularly for complex stamping parts with multiple common processes in production practice, students were unable to determine the number of processes and how they were combined, thus unable to design moderately complex mold structures. To improve stu-

dents 'learning effectiveness and knowledge transferability, based on extensive collection of student feedback and multiple discussions, the teaching content has been reorganized around the mold design process, as shown in Figure 1.

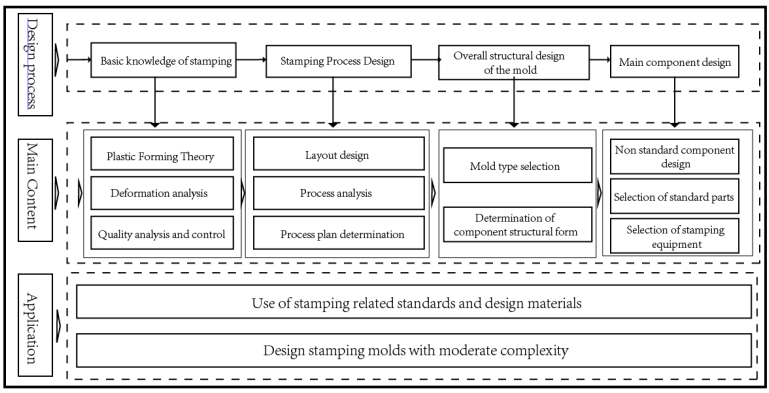

Fig. 1. Mold Design Process Diagram

3.3 Teaching Method Reform

(1)Problem-based Learning

To cultivate students'ability to transfer knowledge and solve real-world problems, a problem-based learning approach is adopted. This method creates problem scenarios to guide students in identifying, an-alyzing, and solving problems related to defects, fostering their logical thinking abilities. This teaching method is extensively used in explaining the design processes of bending and deep drawing molds. For instance, in the section on "Analysis and Control of Ben-ding Part Quality," the focus is on analyzing the deformation process of bending. Using a logical sequence of questions such as "What is this defect? What are the causes? How can it be avoided?" the relationship between the deformation site, material stress, and deformation is analyzed, guiding students to establish a logical thought process for problem-solving. Based on this, students are required to analyze other defects in the bending deformation and other deformation proc-esses, as shown in Figure 2. This approach helps students understand the relationship betw-een bending part quality issues and stress deformation, learn to analyze the causes of stamping quality problems in actual production, and subsequently identify measures to solve the problems. It cultivates students 'ability to identify, analyze, and solve problems.

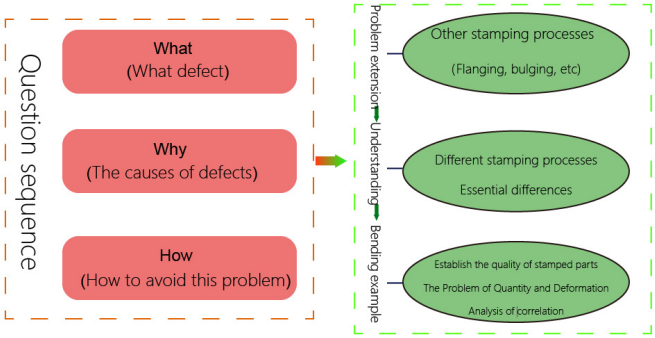

Fig. 2. Sequence Diagram of WWH

(2)Task-driven Approach

Throughout the course, specific tasks are assigned to enhance students 'practical application skills. Students are divided into small groups, with each group assigned a design task. Each design task is unique, requiring students to complete tasks such as process analysis, process scheme development, layout design, process calculation, stamping force and pressure center calculation, overall mold structure design, and component design and selection. This approach allows students to learn while doing, not only acquiring knowledge but also honing their knowledge transfer abilities. It also improves students 'abilities to anal-yze and solve problems, as well as their ability to apply learned knowledge, while fostering teamwork.

(3)Blended Learning

Prior to the course, pre-reading materials, videos, and resources are provided through the SuperStar Learning Platform for students to review. In the classroom, the platform is used for attendance, surveys, interactive bullet screens, and quizzes to gauge students 'pre-reading and learning progress. During br-eaks, interactive activities with students are incorporated, allowing functions such as uploading assignm-ents and monitoring student progress to be performed. This enables real-time monitoring of student learn-ing progress and feedback. Teachers 'instructional materials are uploaded to the learning platform for student review after class. The final group project is a comprehensive application of course knowledge, enhancing teamwork and improving students 'problem-solving abilities.

(4)Case-based Teaching

In the teaching process of stamping mold design, common stamping processes in the production pro-cess are classified. Specific cases of blanking molds, bending molds, and deep drawing molds are used as examples, starting from basic concepts and gradually deepening. The teaching follows the mold design process commonly seen in enterprises, focusing on stamping process design, overall mold structure desi-gn, process calculation, major component design, stamping equipment selection and verification, and dra-wing creation. The teacher clearly defines the task to be completed, imparts relevant knowledge and skills, and then assigns detailed mold design tasks to students,

requiring them to complete them within a speci-fied time frame. Difficult-to-understand content is explained using animations, videos, and other forms to help students understand. Advanced knowledge is also introduced, and students are encouraged to discuss events or production problems, integrating knowledge, skill development, and character education into the teaching process, focusing on students 'comprehensive development.

(5)Integration of Ideological and Political Education into the Teaching Process

This course is a core course in the materials forming and control engineering major. While cultiva-ting students 'abilities in stamping technology and molding design, it adheres to the fundamental task of moral education. Elements such as craftsmanship, safety awareness, and sense of responsibility are in-tegrated into the curriculum to seamlessly blend ideological and political elements with professional ele-ments[4]. During the project implementation process, exemplary stories of advanced figures and labor mo-dels in the mold industry are fully explored, using the power of role models to inspire and guide students to develop a dedicated work ethic. Students are encouraged to learn from the spirit of the great craftsm-anship, who are diligent, resilient, and constantly strive for excellence in their ordinary work positions.as shown in Table 1.

Table 1. Knowledge Points and Integration of Odeological and Political Education into the Curriculum

project	Teaching content	Course ideological and political objectives	Integration method
Project 1 Understanding Stamping	Introduction to Stamping	Cultivate students' national sentiment and establish national confidence	Stories, videos, pictures
	Stamping materials and equipment		
	Theoretical analysis of stamping process		
Project 2 Punching Process and Mold Design	Quality control and process design of punched parts	Cultivate students' ability to analyze and solve problems	Cases and images
	Layout design	Cultivate student team awareness	Cultivate student team awareness
	Calculation of clearance and blade size between convex and concave molds	Calculation of clearance and blade size between convex and concave molds	Video, images
	Introduction to Mold Structure	Introduction to Mold Structure	Cases, animations
	Design of Main Components of Punching Die	Cultivate the great craftsmanship spirit of valuing skills, valuing learning, and pursuing excellence in craftsmanship among students	Cases, videos, pictures

	Selection and verification of punching equipment	Cultivate students' awareness of safety, strengthen the cultivation of professional ethics and humanistic ethics	Case
Project 3 Bending Process and Mold Design	Quality analysis and control of bent parts	Cultivate students' awareness of quality	Cases and images
	Bending process calculation	Cultivate students to connect theory with practice, seek truth from facts, and be meticulous in order to achieve results	Cases
	Typical structure of bending die	Cultivate a spirit of craftsmanship that is hardworking, persevering, and striving for excellence	Cases, animations
	Determination of bending process and mold design	Determination of bending process and mold design	Cases
Project 4 Deep Drawing Process and Mold Design	Quality control of deep drawn parts	Inspire students to take on the mission of serving the country through science and technology	Cases
	Calculation of deep drawing process parameters	Cultivate students to be honest and trustworthy, comply with technical specifications and operating procedures	Cases, animations
	Deep drawing process force calculation and equipment selection	Deep drawing process force calculation and equipment selection	Cases and images
	Deep drawing mold design	Cultivate a spirit of craftsmanship that is hardworking, persevering, and striving for excellence	Cases and images
Project 5 Other Forming Processes	Understanding flipping, flanging, bulging, and necking	Cultivate students' innovative awareness	Cases and animations

4 Exploring and Practicing the Teaching Strategy of "Three Stages, Two Aspects, and Seven Steps"

In the teaching process, we divide instruction into three stages: pre-class, in-class, and post-class. The curriculum covers two main aspects: knowledge and skill development, as well as ideological and political education, comprising a total of seven steps. Using the typical mold structure as an example, we employ the "three stages, dual threads,

seven steps" teaching strategy. The three stages refer to pre-class, in-class, and post-class; the dual threads encompass knowledge and skill development, and ideological and political education. The entire teaching process is divided into seven steps: pre-learning, task intro-duction, task analysis, task implementation, skill enhancement, summarization, and evaluation[5]. Our aim is to cultivate applied talents who can analyze, calculate, design, and innovate.as shown in Figure 3.

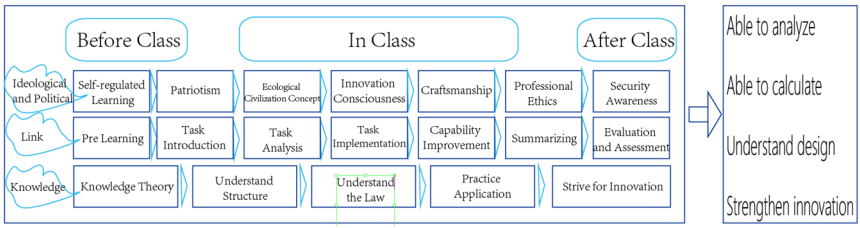

Fig. 3. Teaching Strategy Diagram

5 The Assessment and Evaluation Mechanism for the Course

This course are guided by the OBE concept, focusing on learning outcomes. There is full partic-ipation from industry and the establishment of a collaborative mechanism between the school and ent-erprises, with a diverse assessment approach. The assessment covers knowledge, skills, and qualities, including evaluation content, weight, and methods. Evaluation of knowledge and skills primarily exa-mines the ability to transfer knowledge. Regarding the assessment of student qualities, it is integrated with the ideological and political goals of the course. Using tasks as the carrier, students, teachers, and enterprise mentors collaborate, and a combined online and offline approach is used to comprehensively assess students 'personal cultivation, professional qualities, and the development of their ideals and beliefs.

6 Conclusion

(1)The course reform has led to significant improvements in students 'performance, personal development, and professional skills. Specifically:

(2)The effectiveness of the course construction was notable. A comparison of grades before and after the reform showed an increase in the percentage of excellence by 4.16%, the pass rate by 8.69%, and the average score from 61.02 to 75.43, indicating a marked improvement in student academic performance.

(3)Students showed increased enthusiasm and a stronger sense of honor in participating in skills competitions.

(4)Students performed excellently in course practices, completing tasks with high quality and quantity.as shown in Figure 4.

(5)The course reform enhanced students 'sense of social responsibility, with many actively volunteering during the COVID-19 pandemic,as shown in Figure 4.


Fig. 4. Skills Contest ,Epidemic Prevention and Control Volunteer Course Practice

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