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Update and Adjustment of Basic Course Content in Mechanical Manufacturing Based on Industrial Demand

Zhu Wei, Su Chun

Changzhou Institute of Technology, Changzhou, Jiangsu, China

Abstract: *This article aims to study the updating and adjustment of the content of mechanical manufacturing basic courses based on industrial demand. Firstly, an overview of the basic courses in mechanical manufacturing was provided, including their definition, importance, as well as the characteristics and limitations of traditional content. Subsequently, the impact of industrial demand on basic courses was explored, including the rise of advanced manufacturing technology, the impact of intelligent manufacturing on talent demand, and changes in industry standards and norms. On this basis, methods and directions for updating and adjusting the content of the basic course of mechanical manufacturing were proposed, including the introduction and integration of emerging technologies and processes, cultivation of practical abilities and improvement of experimental teaching, strengthening of industry knowledge and professional competence, as well as updating textbooks and optimizing course design. Subsequently, the relevant content of curriculum implementation and effectiveness evaluation was discussed, including the implementation plan and steps of curriculum reform, the optimization and utilization of teaching methods and learning resources, and the cultivation and evaluation of students' comprehensive qualities. Through the research on updating and adjusting the content of mechanical manufacturing basic courses based on industrial demand, the aim is to improve the pertinence and practicality of the courses, and cultivate high-quality talents that meet the needs of industrial development.*

Keywords: *Industrial demand; Mechanical manufacturing; Basic course content*

1. Introduction

With the rapid development of global manufacturing and the continuous emergence of technological innovation, the mechanical manufacturing industry is facing unprecedented challenges and opportunities. In this rapidly changing environment, cultivating high-quality talents who can meet the needs of the industry has become an urgent problem to be solved in the field of mechanical manufacturing education. As an important component of cultivating engineering and technical talents, the content of the basic course of mechanical manufacturing is closely related to the needs of the industry and directly affects the cultivation of students' practical abilities and competitiveness. The aim of this study is to update and adjust the content of basic courses to adapt to the development trends of the mechanical manufacturing industry by conducting in-depth analysis of its industrial needs. By adjusting the course content, students can improve their practical application ability and innovative thinking, and cultivate outstanding talents who meet industry standards. This has positive significance for improving the quality of talent in the field of mechanical manufacturing, promoting industrial upgrading and innovative development.[1]

2. Overview of Mechanical Manufacturing Fundamentals Course

2.1. Definition and importance of basic courses in mechanical manufacturing

The basic course of mechanical manufacturing is one of the core courses in engineering and technology majors, aimed at providing students with basic theories, knowledge, and skills in the field of mechanical manufacturing. This course typically covers topics such as Materials and Technology, Fundamentals of Mechanical Design, Manufacturing Engineering and Technology, and Numerical Control Technology, laying a solid theoretical foundation for students to understand and apply key concepts in the field of mechanical manufacturing.[2]

ISSN 2522-6398 Vol. 6, Issue 31: 86-92, DOI: 10.25236/FER.2023.063115

The basic course of mechanical manufacturing plays an important role and position in the cultivation of engineering and technical talents. The basic course of mechanical manufacturing provides students with a systematic knowledge system of mechanical manufacturing, helping them establish a solid foundation in materials, processes, design, and manufacturing; Through experiments and practical activities, students can apply the theoretical knowledge learned in the classroom to practical operations, cultivate their hands-on ability and practical application skills; With the continuous innovation and technological updates in the field of mechanical manufacturing, the content of basic courses in mechanical manufacturing needs to be constantly adjusted to enable students to adapt to the new requirements and trends of industrial development; The basic course of mechanical manufacturing is the foundation of subsequent advanced professional courses, laying a foundation for students to deepen their learning of more professional and in-depth knowledge in the field of mechanical manufacturing.[3]

In the entire engineering and technical talent training system, the basic course of mechanical manufacturing plays an important role in connecting theory and practice, as well as connecting basic and advanced courses. It plays an irreplaceable role in cultivating well-rounded mechanical engineering and technical talents.

2.2. Characteristics and limitations of traditional mechanical manufacturing foundation course content

Traditional courses focus on establishing a comprehensive theoretical system of mechanical manufacturing, including materials science, technology, mechanical design, etc., to ensure that students acquire a systematic foundation of knowledge; The course usually includes experimental sections, emphasizing students' basic operational skills, such as processing technology experiments, mechanical design practices, etc., to cultivate their practical hands-on abilities; Emphasis is placed on imparting basic concepts, principles, and norms in the field of mechanical manufacturing to students, laying a solid theoretical foundation for them.[4]

However, traditional mechanical manufacturing foundation courses also have some limitations. With the development of technology, new technologies and processes are constantly emerging in the field of mechanical manufacturing. However, traditional course content updates are relatively lagging behind, making it difficult to cover the latest industry development trends. Mechanical manufacturing involves multiple disciplinary fields, and traditional course content is difficult to fully integrate, resulting in students having difficulty forming a systematic and comprehensive understanding. Traditional courses tend to overly focus on imparting theoretical knowledge, while there is a need to strengthen the cultivation of practical application and problem-solving abilities. With the rise of intelligent manufacturing, traditional course content has not fully covered knowledge and skills in the field of intelligent manufacturing, affecting students' ability to adapt to modern manufacturing.

Traditional mechanical manufacturing basic courses to some extent meet the needs of students for basic knowledge and skills, but also face challenges that cannot adapt to rapidly changing industry demands and emerging technologies. Therefore, it is necessary to update and adjust the course content to better meet the requirements of industrial development.[5]

3. The impact of industrial demand on basic courses

3.1. The Rise of Advanced Manufacturing Technology

With the rapid development of technology, advanced manufacturing technology has emerged in the field of mechanical manufacturing, posing new challenges to basic courses. Traditional mechanical manufacturing foundation courses often focus on teaching traditional manufacturing processes and materials, without fully covering advanced manufacturing technologies such as 3D printing, laser cutting, automated manufacturing, etc. Therefore, updating the basic course content needs to keep up with the pace of advanced technology, introduce relevant theories and practices, to ensure that students master the core knowledge of today's advanced manufacturing field.[6]

In this context, the adjustment of basic courses should focus on introducing the basic principles, application scope, and future development trends of advanced manufacturing technology. Especially through case analysis and experimental teaching, students can deeply understand the working principles of these new technologies and cultivate their ability to flexibly apply them in practical applications. This update will help cultivate engineering and technical talents who can adapt to the future development of

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the manufacturing industry.

3.2. The Impact of Intelligent Manufacturing on Talent Demand

The rapid popularization of intelligent manufacturing has led to an increasing demand for engineering and technical talents with relevant skills in society. Traditional mechanical manufacturing basic courses have not fully considered the content of intelligent manufacturing, which leads to application bottlenecks for students when facing intelligent production environments. Therefore, basic courses need to be adjusted to cover knowledge related to intelligent manufacturing, including artificial intelligence, the Internet of Things, big data, etc. When updating course content, basic concepts, key technologies, and application cases of intelligent manufacturing can be added. At the same time, through practical projects and simulation scenarios, cultivate students' problem-solving abilities, enabling them to work collaboratively in intelligent manufacturing environments and adapt to new technologies. This adjustment will help meet the urgent demand of the industry for engineering and technical talents with intelligent manufacturing backgrounds.[7]

3.3. Changes in Industry Standards and Norms

With the globalization of manufacturing, industry standards and regulations are constantly changing. Traditional basic course content may not be updated in a timely manner to reflect these changes, resulting in students having difficulty meeting the latest industry standards in their actual work. Therefore, the updating of basic courses requires close attention to the latest developments in current industry standards and norms. In basic courses, students can understand and adapt to industry requirements by introducing the latest standards and norms. Through case studies and practical projects, cultivate students' understanding and application abilities of standards and norms. Such adjustments will help cultivate students with professional ethics that follow industry standards and norms, and improve their practical operational skills in engineering projects.[8]

Under the influence of industrial demand on these three aspects of basic courses, adjusting the content of mechanical manufacturing basic courses will help better meet the needs of students and the industry, and cultivate more competitive and adaptable engineering and technical talents.

4. Update and adjustment of the content of the basic course of mechanical manufacturing

4.1. Introduction and Integration of Emerging Technologies and Processes

In order to ensure that the basic courses of mechanical manufacturing are synchronized with the development of advanced manufacturing technology, it is necessary to actively introduce and integrate emerging technologies and processes. Among them, focusing on knowledge in fields such as 3D printing, laser cutting, and automated manufacturing is the primary task of updating course content. These emerging technologies are playing an increasingly important role in today's manufacturing industry, therefore, students should have a profound understanding of their basic principles, scope of application, and practical applications. In the updated course content, a thorough analysis of these new technologies should be conducted. It is not only necessary to convey the external appearance of technology, but also to enable students to understand the engineering principles and scientific foundations behind it. By emphasizing practical applications, students will be able to better transform their learned knowledge into the ability to solve practical problems. In addition, through practical projects and case studies, students can apply their knowledge in simulated real scenarios and deepen their understanding of emerging technologies. In order to cope with the complex and ever-changing manufacturing environment of today, the update of the basic course of mechanical manufacturing should also focus on integrating different emerging technologies. This involves cultivating students' interdisciplinary comprehensive application abilities. Curriculum design can involve setting up comprehensive projects that require students to combine different emerging technologies to solve challenging practical problems. This practice will encourage students to form a more comprehensive understanding in practical applications, enabling them to better adapt to the development needs of the manufacturing industry.[9]

By comprehensively updating the basic courses of mechanical manufacturing and introducing and deeply integrating emerging technologies and processes, students will better adapt to the rise of advanced manufacturing technologies today. This not only helps to improve their employment competitiveness, but also lays a solid foundation for their future innovation and development in the manufacturing field.

ISSN 2522-6398 Vol. 6, Issue 31: 86-92, DOI: 10.25236/FER.2023.063115

4.2. Training of practical abilities and improvement of experimental teaching

In order to ensure that the basic course of mechanical manufacturing can better cultivate students' practical operation skills, it is necessary to focus on the cultivation of practical abilities and achieve this goal through comprehensive improvement of experimental teaching. The improvement of practical ability not only means that students can proficiently apply theoretical knowledge, but also requires them to conduct practical operations in simulated real work environments to cultivate their ability to flexibly cope with various challenges in future work. The improvement of experimental teaching is regarded as a key link in cultivating students' practical abilities. By designing challenging experimental projects, students can be motivated to learn and guided to actively participate in practical activities. These projects should cover multiple aspects of the field of mechanical manufacturing, enabling students to comprehensively master relevant skills. Introducing practical problems from the industry in experimental projects helps cultivate students' ability to solve practical challenges, thereby improving their practical application abilities. In order to better simulate the real working environment, it is necessary to introduce virtual simulation technology and advanced experimental equipment. Virtual simulation technology can provide a safe and controllable environment for students to practice in simulated manufacturing scenarios, reducing the risks caused by experimental errors. At the same time, advanced experimental equipment can simulate complex manufacturing processes, allowing students to be exposed to more advanced and efficient manufacturing technologies in the laboratory, and improving their practical operational level. Through practical teaching, students will be able to have a deeper understanding of the key links in the manufacturing process, which will help them cope with various manufacturing problems more calmly in their future work.[10]

4.3. Strengthening Industry Knowledge and Professional Literacy

The updating and adjustment of the basic course of mechanical manufacturing not only requires attention to technological progress, but also strengthens students' industry knowledge and professional competence. This means focusing more on industry standards, practical operational norms, and the cultivation of interdisciplinary skills. Firstly, for industry knowledge, course updates need to keep up with the latest developments in the industry. Introduce new concepts such as intelligent manufacturing and digital technology to help students understand the direction and trends of future manufacturing. This includes the principles of Industry 4.0, advanced manufacturing processes and equipment, as well as data management and intelligent production in digital manufacturing. Through case analysis and sharing of practical industrial experience, students will be able to gain a deeper understanding of the current development status of the industry and prepare for future employment. Secondly, strengthening professional competence is also crucial. This not only includes technical skills, but also involves soft skills such as engineering ethics, communication skills, and teamwork. Curriculum design should focus on cultivating students' comprehensive literacy, such as strengthening their collaborative abilities through project management and team collaboration practices. In addition, emphasizing the education of engineering ethics will help them to handle problems more responsibly and maintain professional ethics in their future work.

To achieve these goals, curriculum updates can adopt diverse teaching methods. Introduce industry experts to give lectures or collaborate with enterprises to carry out projects, allowing students to gain a deeper understanding of industry needs and application scenarios. Simulate real-life cases and situations to help students get closer to real-life work scenarios, and cultivate their ability to solve problems and respond to challenges. At the same time, the evaluation methods should also be diversified. In addition to traditional exam evaluation, more project evaluation or practical task evaluation should be used to comprehensively understand the comprehensive abilities of students. The key to course updates lies in the training and support of the teacher team. Teachers need to keep up with the pace of industry development, update their knowledge reserves, and understand the latest teaching methods and tools. The establishment of professional development training, teaching seminars, and teaching resource sharing platforms are important means to support the growth of the teaching team, thereby leading students towards the correct direction of career development.

4.4. Textbook updates and course design optimization

The updating and adjustment of the basic course of mechanical manufacturing requires close attention to textbooks and course design to ensure that students acquire the latest knowledge and cultivate practical application abilities. The textbook should cover the latest mechanical manufacturing technologies,

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materials, and processes. Including but not limited to new developments in intelligent manufacturing, digital production, and material engineering. The content of the textbook should reflect current industry standards and best practices, ensuring that students graduate with up-to-date knowledge. By introducing real cases and practical applications, analyzing successful and failed cases, students can learn from them and develop problem-solving abilities. Integrate multimedia resources, including videos, simulation software, and online experimental platforms, to provide a more vivid and intuitive learning experience. Integrating mechanical manufacturing with other related fields such as electronic engineering and computer science to cultivate students' interdisciplinary thinking.

Centering course design around projects and involving students in real-world problem-solving. This helps to cultivate students' practical application skills, team collaboration, and project management skills. Strengthen experiments and practical operations to ensure that students can personally experience various aspects of mechanical manufacturing. At the same time, curriculum design should consider individual differences among students and provide flexible learning paths. According to the interests and career directions of students, set up elective courses or professional directions to make the courses more tailored to individual needs. Adopting diverse evaluation methods, including project evaluation, experimental reports, team collaboration evaluation, etc. Through comprehensive evaluation, gain a more comprehensive understanding of students' learning outcomes and ability development. Design timely and effective feedback mechanisms to help students understand their learning progress and provide guidance for improvement.

Through these textbook updates and optimization measures in course design, the basic courses of mechanical manufacturing will better meet the needs of students and the industry, and cultivate engineering talents with more practical application abilities and innovative thinking.

5. Implementation and effectiveness evaluation

5.1. Development and implementation of implementation plans

The update and adjustment of the basic courses in mechanical manufacturing are aimed at closely paying attention to industry needs and ensuring that students have skills that meet industry standards and practical job requirements. In the process of formulating and implementing the implementation plan, we will take a series of measures to make the course more forward-looking and practical. Firstly, we clarify the objectives of course updates. By analyzing industry trends in depth, we will clarify the key abilities for cultivating students, such as digital manufacturing, intelligent manufacturing, etc. This helps ensure that students can quickly adapt and contribute to the constantly evolving industrial environment after graduation. Secondly, conduct in-depth industry research. Establish close ties with enterprises, invite industry experts to participate in course planning, in order to timely understand current and future industry needs. Through such collaboration, the course content can be better aligned with practical work scenarios, ensuring that students have the practical skills required by the industry after graduation. In order to adapt to the trend of digitalization and intelligence in the manufacturing industry, we will integrate mechanical manufacturing with other related fields. Introducing interdisciplinary elements such as electronic engineering and information technology to cultivate students with a more comprehensive skill set, enabling them to participate in complex projects and be competent for future intelligent manufacturing work. Teacher training is a crucial part of implementing the plan. We will provide systematic training for teachers to familiarize them with the latest technologies and industry trends. Through such training, teachers will better understand the needs of the industry, improve their teaching level and insight into industry development. Updating laboratory equipment is a crucial step in ensuring students' practical abilities. We will introduce advanced manufacturing equipment and simulation technology to ensure that students can obtain the latest skill experience in practical operations. This not only enhances the practicality of the laboratory environment, but also enhances students' adaptability in real-world industrial scenarios. Finally, we will introduce project driven teaching methods. Through practical project solutions, students will face complex industrial problems and develop practical problem-solving abilities. Through this series of implementation plans, the basic course of mechanical manufacturing will be developed into an educational program that is more in line with industry needs, forward-looking, and practical, providing students with more comprehensive career preparation.

5.2. Effectiveness evaluation methods and indicators

In order to comprehensively evaluate the effectiveness of course updates and adjustments, multiple

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methods and indicators need to be adopted. Through regular exams, assignments, and project evaluations, students can objectively assess their mastery of professional knowledge in the field of mechanical manufacturing. These assessments can help teachers understand students' mastery of course content and make necessary adjustments and improvements based on the evaluation results. In order to evaluate students' practical operational abilities in the laboratory environment, they can be required to submit experimental reports and undergo practical operational assessments. The experimental report can demonstrate students' understanding and analytical ability of the experimental process and results, while the practical operation assessment can evaluate students' skills and safety awareness in laboratory operations. The projects in the course are an important part of cultivating students' comprehensive abilities and teamwork abilities. By evaluating the projects that students participate in, the innovation, practicality, and teamwork ability of the projects can be evaluated. Evaluation can include an evaluation of project outcomes, as well as an assessment of student performance and contributions in the project. Student feedback is crucial for improving and adjusting the curriculum. Students can collect feedback on the course through course evaluation questionnaires, group discussions, individual interviews, and other methods. These feedback opinions can help teachers understand students' feelings about teaching content, methods, and resources, so as to adjust and improve the curriculum in a timely manner. Establishing connections with industry enterprises can obtain their assessment of the employability of graduates, thereby verifying whether the course meets actual employment needs. By collaborating and communicating with industry enterprises, we can understand the industry's requirements for students' skills and abilities, and further guide the updating and adjustment of courses.

5.3. Evaluation of the effectiveness of course updates and adjustments

First, schools need to pay close attention to the employment situation of graduates, especially observe whether the employment rate has increased significantly in the related manufacturing industries. In addition, schools should assess the level of cooperation with the industry, including how many companies provide internships for students and how many projects work together between the school and the industry to ensure that students have access to the real industrial environment. At the same time, students' academic performance is also one of the important indicators of evaluation. By focusing on students' published papers and participating in competitions, it can reflect whether the course can effectively develop their innovative thinking and research skills. In order to further understand the long-term effects of the course, the university should also follow up the graduates to track their achievements in the workplace and their continuous learning. Finally, schools should establish a regular evaluation mechanism to continuously optimize the curriculum content and teaching methods based on the collected evaluation results to ensure that the curriculum can always meet the needs of the industry.

Through such a systematic evaluation, schools can better understand the actual effects of curriculum updates and adjustments, providing experience and reference for future reforms. This not only helps students better adapt to industry needs, but also helps schools maintain teaching quality and leading position.

6. Conclusion

The update and adjustment of the basic course of mechanical manufacturing aims to make it more in line with the constantly developing industrial needs of today, in order to cultivate engineering professionals with practical skills and innovative thinking. Through in-depth industry research and the implementation of comprehensive curriculum reforms, we aim to provide students with a more forward-looking and adaptable learning experience. This process not only focuses on imparting knowledge, but also on cultivating students' practical operational skills, teamwork spirit, and ability to adapt to future industrial challenges.

In the future, we will continue to strive for continuous improvement and innovation in our curriculum, closely cooperate with the industry, and keep up with technological development trends. We hope that through this process of updating and adjusting, graduates will better adapt to the future industrial environment, make positive contributions to society, and demonstrate outstanding performance in different fields. In the constantly changing trend of the times, the basic course of mechanical manufacturing will continue to play a leading role, providing students with a solid disciplinary foundation and practical experience for their growth and development.

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References

[1] Wang Qiuyan, Liu Dong, Dong Chunlan, Zheng Xiangpan. Exploration of Innovative Teaching Mode for the Fundamentals of Mechanical Manufacturing Technology in Applied Universities [J]. Journal of Higher Education, 2023, 9 (36): 70-74

[2] Chen Hui, Zhu Hai, Liu Lin. Exploration and Practice of the Curriculum Reform of "Fundamentals of Mechanical Manufacturing" under the Background of New Engineering [J]. Mechanical Engineer, 2023, (12): 4-6

[3] Guo Pushan, Liu Yaxuan, Pan Haijun, Zhang Yi. Research on Optimization of Online and Offline Integrated Teaching Mode for Intelligent Manufacturing Engineering - Taking the Course of "Fundamentals of Mechanical Manufacturing Technology" as an Example [J]. Education and Teaching Forum, 2023, (47): 169-172

[4] Zhang Yan. Exploration of the Reform of Mechanical Manufacturing Process Fundamentals Course under the Background of Intelligent Manufacturing Industry [J]. Agricultural Machinery Use and Maintenance, 2023, (10): 151-154

[5] Deng Ling, Li Sheng. Exploration of Teaching Reform in Mechanical Design Fundamentals under the Background of Intelligent Manufacturing [J]. China Machinery, 2023, (28): 99-102

[6] Zhang Jia, Wu Chunya, Guo Bing, Gao Shengdong, Pan Xudong, Wang Zhenlong. Ideological and Political Practice and Reflection on the Course of Mechanical Manufacturing and Automation in Universities: Taking the Course of "Fundamentals of Mechanical Manufacturing Technology" as an Example [J]. The Road to Success, 2023, (20): 117-119

[7] Zhou Ziyun. Exploration of Reform in the Assessment of Mechanical Manufacturing Technology Fundamentals Course [J]. Scientific Consultation (Education and Research), 2023, (06): 50-52

[8] Shen Jiancheng, Yan Huiping, Liu Limei, Luo Wenchui, Yi Xiangbin. Practice and Exploration of the Curriculum Reform of "Fundamentals of Mechanical Manufacturing" [J]. Southern Agricultural Machinery, 2023, 54 (12): 178-180

[9] Ban Zixuan, Xu Weiping, Wu Di. The Application of Online and Offline Blended Teaching in Engineering Courses - Taking the Course of "Fundamentals of Mechanical Manufacturing Technology" as an Example [J]. Equipment Manufacturing Technology, 2023, (05): 192-196

[10] Zheng Shengli, Li Guohui, Li Guoqiang, Wang Yanhong, Wang Yuntao. Research and Design on Teaching the Craftsman Spirit of "Fundamentals of Mechanical Manufacturing Technology" Based on Course Objectives [J]. Technology Wind, 2023, (13): 16-18