Teaching Reform and Practice of Intelligent Manufacturing Engineering Professional Foundation Courses in the Context of New Engineering Disciplines: Take the Course "Fundamentals of Mechanical Design" as an Example

Ge Liu, Yao Xue, Ying Ma, Lin Du

School of Robotics Engineering, Yangtze Normal University, Chongqing, China

Abstract: The intelligent manufacturing engineering major is a typical cross-discipline, based on mechanical, big data, electronic information, and other majors, and at the same time, the intelligent manufacturing engineering major is an innovative and applied discipline. Under the concept of new engineering education, the manufacturing intelligent engineering profession faces new opportunities and challenges. Among them, the basic course of mechanical design, as the basic course of engineering emphasized by the new engineering discipline, to rationalize the connotation of the new engineering discipline under the new era, new opportunities, and new challenges, it is necessary to quickly identify the curriculum problems. explore the methods of curriculum reform, recognize the current situation of curriculum education and a series of problems in the curriculum, strengthen the education of students' professional cognition and curriculum cognition. construct the professional curriculum system that is adapted to the needs of the new era and the new engineering discipline. We will streamline and improve the teaching content of the existing courses and adjust the relevant course evaluation.

Keywords: Basic Mechanical Design; New Engineering, Intelligent Manufacturing Engineering; Curriculum Teaching

1. Introduction

As a typical engineering foundation course, the foundation of mechanical design is in an important position in the curriculum of intelligent manufacturing engineering, and the course can help students better understand the structure of the product as well as the working principle when designing, and guide students to systematically design a product. With the proposal of the concept of a new engineering objectives discipline. the course and curriculum system of the entire intelligent manufacturing engineering profession should be adjusted according to the industrial demand and the current state of technological development, to play the main role of engineering discipline [1]. The content of the basic mechanical design course is the basic knowledge required for students to carry out the innovative design of engineering products, universities and colleges and should rationalize the connotation of the new engineering discipline, find out the problems of the course, and explore the methods of course reform in the new era. new opportunities and new challenges. This paper analyses the teaching system and teaching mode of the basic mechanical design course and concludes that the following points need to be improved and adjusted.

1.1 Insufficient Systematization and Relevance of the Curriculum

Looking at the construction of the teaching system of the basic mechanical design course and the arrangement of the course structure in various colleges and universities, it can be found that there are still many colleges and universities that have problems such as independent chapters and separation of science and practice in the arrangement of the content of the basic mechanical design course. Most schools still use serial learning mode, that is, the first instruction of theory, and then in the subsequent courses, the unified arrangement of practice, theory, and practice teaching time interval is too long, resulting in students having difficulty directly grasping the intrinsic

connection between the theory course and the practice course, there is the problem of broken knowledge chain, not only the degree of ability to practice is not good, the theory of the learning is also not deep enough [2]. In addition, there is also a part of the school's curriculum arrangement that has a serious problem of emphasizing theory and neglecting explain Teachers theoretical practice. knowledge in class, while practical tasks are left to students to complete independently, in-depth explanations targeted without exercises, and practical teaching.

1.2 Lack of Course Content

A large number of artificial intelligence modern technologies and information technologies have been introduced into the machinery manufacturing industry, and a large number of manufacturers have introduced robot operations in their production and manufacturing assembly lines. However, the existing basic mechanical design course materials lack artificial intelligence-related content, and there is no special matching unit for robots for intelligent manufacturing. Specifically, there is a lack of modern design methods such as computer-aided design and simulation design, theoretical and practical contents related to the design of new mechanical structures in the context of the era of intelligent manufacturing, as well as integrated courses on electromechanical control and other disciplines that are suitable for the design of modern mechanical equipment and can assist in mechanical design.

1.3 Curricula are Outdated and Old

The knowledge and technology learned by the students are relatively backward and not in line with the mainstream technology of the current industry, resulting in the majority of students not being able to adapt quickly to their jobs after graduation or still needing to undergo a longer period of training in modern design methods and manufacturing processes before they can be competent for their jobs. For example, today's basic mechanical design textbooks, still spend a lot of space explaining the mechanical principles of the part of the drawing method. However, these contents are no longer in line with the needs of contemporary technological development, only as a history of development or theoretical basis in the class a little explanation can be, without in-depth study.

1.4 Lack of Product-specific or Real-life Project Training

In teaching, it is necessary to help students consolidate their knowledge through examples or practice problems and let students master the application of knowledge and skills in practice. However, most of the current examples and practice problems are biased towards the examination of student's mastery of knowledge, lack of systematic training of hands-on practical skills, no specific product design or real project training associated with the content of the chapter, and weak relevance to the real market and industry [3].

1.5 Lack of Development of Innovative and Creative Skills

Nowadays, the industry and society need comprehensive and complex talents with innovative consciousness. This requires students not only to master the method of mechanical design but also to have the innovative thinking and creative ability of technology. However, in the traditional curriculum design and teaching methods, the ability of students is slightly insufficient, for example, the lack of independent design ability, questioning the spirit of students in teaching, and creative thinking training, students can master the knowledge of the textbook and the teacher in the classroom to explain the problem, but in the actual innovation, but the performance of the lack of power, and part of the students have a sense of innovation, innovative ideas, but the practice and creative ability Some students have innovative consciousness and innovative ideas, but their practical and creative ability is not enough to put such ideas into practice. Therefore, the teaching methods and strategies of the program still need to be improved.

2. Innovative Strategies for the Mechanical Design Foundation Course of Intelligent Manufacturing Engineering in the Context of New Engineering Disciplines

2.1 Emphasis on the Systematic and Interrelated Nature of Course Content Systematic innovation in course content aims

to prevent knowledge fragmentation and

breakage in students' learning processes. Mechanical design in the context of the intelligent manufacturing era should start from the overall function of the product, improve the overall scheme and overall design, the performance determine parameter requirements of the whole system, and then consider the selection and design of each component and mechanism. It is worth noting that the mechanical design of the intelligent era should not only consider the mechanical system but also configure the auxiliary electromechanical fluid system based on the electromechanical control integration intelligent requirements of equipment. Therefore, the systematic innovation of the content of the basic mechanical design course should be based on ensuring that the course system has the design theory and design method of modern intelligent manufacturing equipment as a whole, cultivating students' global awareness and global concepts, ensuring that students have the knowledge structure of the overall design, and being able to understand the core design method of the system of the traditional type and the common structure of the system [4]. The relevance of the course content is mainly to link the knowledge points of each independent chapter, to link the theory and practical teaching, to help students establish the overall concept of integration of theory and practice, and then improve the practical ability of students.

2.2 Completion of the Curriculum

The content of the basic mechanical design course should keep abreast of the times, take into account the current technological development of intelligent equipment, and integrate some new components as well as new design ideas or technologies into the teaching content to enrich the cognitive system of students and expand their knowledge course horizons. Firstly, content supplementation should focus on introducing various robots used in intelligent manufacturing. This includes robot types, kinematics, dynamics fundamentals, and the basic theories of typical robots, as well as their applications in contemporary production. Secondly, to update the mechanical type parts, including but not limited to viscous coupler, hydraulic coupler, etc. Finally, the content related to the structure of components and

their common design methods are added to the original course system to improve the content of the basic mechanical design course, and to prevent students from restricting their innovative thinking due to insufficient cognition and too narrow knowledge.

2.3 Adaptation of Old Knowledge Points and Programmed Content

Based on the original curriculum. appropriately delete some of the knowledge points that have been eliminated by the times as well as the over-programmed teaching structure, such as the diagramming of the connecting rod mechanism, the diagramming method of normal cam, etc., which are no longer applicable to the content of mechanical design in the context of the era of intelligent manufacturing, and replace them with modern design methods involving this aspect of the content of [5,6].

2.4 Adding a Penetrating Case Teaching in the Whole Teaching Process

To highlight the practicality of the teaching content, emphasizing the cultivation of students' overall design consciousness, task decomposition ability, and hands-on practical ability. In terms of teaching, highlight the organic linkage between theory and practice, so that real cases throughout the teaching process, so that students think about the design ideas of the case from a realistic perspective. For post-course exercises, it's important to expand or innovate on traditional and typical cases, helping students learn through examples and apply their knowledge to solve new problems [7,8].

2.5 Emphasis on the Cultivation of Innovation Ability

Basic mechanical design course reform must highlight the training of students' innovation ability, to let students master a solid theoretical foundation, with strong practical ability under the premise, actively play a personal innovative spirit and creative consciousness, and design better and more contemporary works. Cultivate students' innovation ability. to make students fully understand the ins and outs of the knowledge and theoretical clear mechanical foundation, design technology, and the development of intelligent manufacturing, so that students in the process

of understanding the development of technology, innovative attempts, and through the development of such technology in the process of innovation cases to inspire students to think, so that students realize the power of innovation. In teaching, teachers introduce real projects, actual design cases, and disciplinary competitions to give students an immersive learning experience, and then cultivate students' ability to apply what they have learned and their awareness of innovation in practice [9].

3. Conclusion

In the era of intelligent manufacturing, the traditional mechanical design and mechanical manufacturing industry has undergone great changes, and the basic mechanical design course is an important basic course for all mechanical majors. To keep pace with the development of the times, cultivate more excellent talents near mechanical majors for society, and promote the implementation of the intelligent manufacturing strategy, colleges and universities should seriously analyze the deficiencies in the construction of the existing basic course of mechanical design, based on the background of the new era, optimize the curriculum design, promote curriculum reform, improve the drawbacks of the traditional basic course system, continue to improve the construction of the curriculum, and cultivate excellent technical talents, innovative talents, and complex talents. Talents, innovative talents, complex talents.

Acknowledgement

This work was supported by Yangtze Normal University Project: 010631062

References

[1] Xia Yanjing. Discussion on the curriculum structure of art design undergraduate programs in China's colleges and universities. Nanjing: Nanjing Art Institute, 2006.

- [2] Gui Liang, Jin Yue, Guo Ting et al. Exploring the reform of basic mechanical design experimental teaching for the cultivation of innovative design ability. Journal of Higher Education, 2022, 8(31):40-44.
- [3] Yang Fuchun, Yue Xiaoming, Chen Long. Exploration of the teaching reform of basic mechanical design course under the background of intelligent manufacturing. University Education, 2022(07):78-80.
- [4] Liu Kai, Xue Dongqi. Teaching reform of practical aspects of basic mechanical design course. Agricultural machinery use and maintenance, 2021(11):141-142.
- [5] Wei Bo, Wang Tian, Zhang Jing. Teaching Reform and Exploration of Open Concept in "Basic Mechanical Design" Course under the Background of Applied Transformation. Science and Technology Vision, 2021(29):39-40.
- [6] Lou Xiuhua, Du Weimin, Yao Hairong. Mechanical Design Foundation Course Content Reform and Diversified Teaching Method Innovation and Practice. China Modern Education Equipment, 2018(21):29-31.
- [7] WISINSKI J, YU A. Is the Bloom taxonomy level of student generated exam style questions predictive of exam perfor mance? The FASEB Journal, 2020, 34(S1):1-1.
- [8] Lu Hao, Wang Wei. Design and Practice of Civics Teaching in Basic Mechanical Design Course. Education Teaching Forum, 2020(30): 81-82.
- [9] Zhu Shuangxia. Exploration and practice of online blended teaching mode of "basic mechanical design" course. Southern Agricultural Machinery, 2021, 52(13):129-132.