Applying Digital Intelligent Design to Reform the Teaching Mode of "Mechanical Drawing Practice" Course

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Abstract: This paper explores the teaching reform methods of the practical course of mechanical drawing. Adopting a combination of online and offline teaching methods. The theme of this reform is digital intelligent design, which changes the traditional teaching method of mechanical drawing practice courses mainly based on two-dimensional drawing. Teachers guide students in learning surveying and mapping components, and students use 3D software to model the components. After the modeling is completed, add working conditions, analyze the stress situation of the components, identify weak links, and optimize the design. By reforming teaching methods, reducing the leading role of teachers and highlighting student autonomy. Enhance students' interest in learning and enhance their ability to learn independently. The ultimate goal is to achieve significant results in improving student performance and enhancing extracurricular competition abilities, laying the foundation for innovative practice.

Keywords: Mechanical drawing practice, teaching reform, blended online and offline teaching, digital intelligent design

1 introduction

Mechanical drawing is a fundamental technical course in engineering majors[1]. The practical stage of mechanical drawing is an important node in the transition from basic theoretical knowledge of drawing to practical application abilities such as drawing and reading. In the drawing practice class, students surveyed mechanical components and gained a preliminary understanding of engineering requirements such as the structure and working principle of components. Therefore, this course has played an enlightening role in cultivating students' engineering qualities. In the teaching process of mechanical drawing practical courses, efforts should be made to enhance students' innovative thinking awareness, rigorous engineering professional literacy, and hands-on practical operation ability as the main starting point, in order to cultivate technical talents in the new era[2].

With the continuous development of the global economy, China's industrial manufacturing has moved towards intelligence. The development of manufacturing industry not only relies on the practical experience of traditional processes, but more importantly, on the combination with modern science and technology[3]. The product quality of mechanical design is directly related to the technology used in its design and manufacturing process. On the basis of gradually increasing user needs, advanced digital and intelligent manufacturing methods can better meet

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user requirements. Under the new wave of economic development, digital design and intelligent design will play a more important leading role, leading the digital transformation and development of the entire industry. Schools should also keep up with the development trends of technology and industry, and provide systematic training for students.

The teaching design and implementation of graphic practice courses have a direct or indirect impact on the learning of subsequent professional courses, as well as practical work after graduation. How to break the traditional and inherent practice mode, design reasonable and effective teaching content, and implement diverse and efficient teaching methods is the core content of exploring the teaching reform of mechanical drawing practice. Some scholars [4-11] have carried out teaching reforms in terms of teaching methods and performance evaluation. The main focus of everyone's discussion is to reduce the dominant position of teachers and highlight the autonomy of students; In terms of assessment methods, add process assessment and other aspects.

2 The Traditional Teaching Mode of Mechanical Drawing Practice Course

The traditional teaching mode of mechanical drawing practice course is mainly based on knowledge transmission and indoctrination. The teaching content is basically about surveying and mapping components, as well as completing a certain amount of freehand and ruler drawing. The teaching objectives are single, and the teaching content is isolated and closed. This teaching model, which mainly focuses on knowledge transmission and indoctrination, provides too little content for students to think about, and there are too few areas for independent learning and innovation, which is not conducive to improving spatial imagination ability and stimulating learning interest [12]. This is not in line with the current goal of cultivating engineering applied talents with innovative spirit in students, and is not in line with the demand for talents in society.

The traditional practical teaching of mechanical drawing is not suitable for the development of the new era, which is manifested in the following aspects:

Traditional two-dimensional design is only used for designing engineering drawings and cannot meet the information requirements of subsequent courses such as CAE/CAM/PDM. It is also unable to express complex surfaces, shape and render, and has poor animation ability, making it difficult to provide a foundation for subsequent course design and graduation project.

Teaching based on two-dimensional design is time-consuming and difficult to grasp and understand.

The curriculum system is loose and does not consider the interrelationships between courses, making it impossible to form an information chain for the entire product lifecycle from design to manufacturing.

The knowledge imparted is outdated and cannot fully reflect the characteristics of modern manufacturing technology, thus unable to meet the needs of employers.

A large amount of drawing and editing work prevents students from focusing their main energy on innovative design. This is also not conducive to cultivating students' comprehensive innovation ability[13-15].

3 Reform of Teaching Mode for Mechanical Drawing Practice Course

This course reform focuses on digital intelligent design, constructs online courses, and adopts a blended online and offline teaching method. Comprehensively test and strengthen the knowledge learned by students, with a focus on training their hands-on operation ability, independent use of comprehensive methods to solve problems, surveying and mapping ability, and component expression ability. Stimulate students to develop a strong interest in mechanical drawing practice. Cultivate a team spirit of unity and cooperation among students, as well as a rigorous and meticulous work style. The flowchart of the blended teaching mode for mechanical drawing practice is shown in Figure 1.

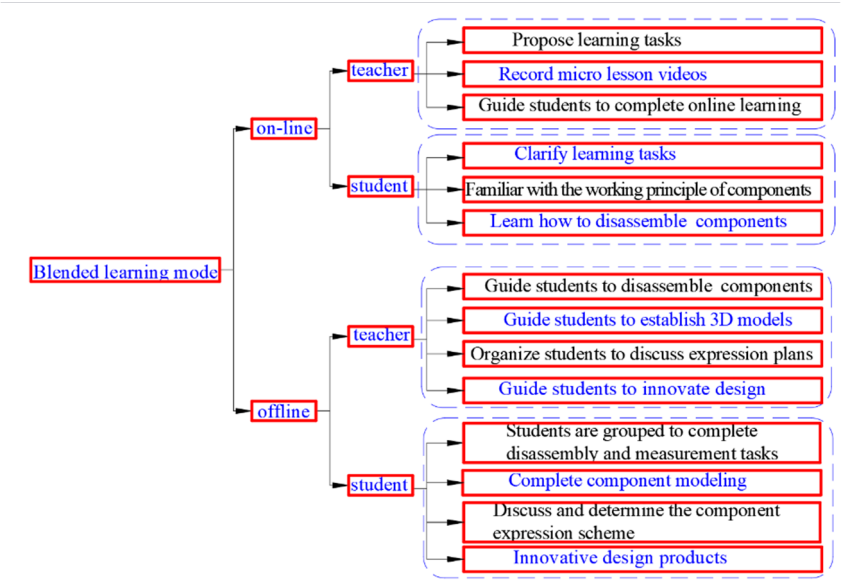

Figure 1 Flow Chart of Hybrid Teaching Mode for Mechanical Drawing Practice

The main content of traditional mechanical drawing practice courses is to survey mechanical components and draw two-dimensional engineering drawings. In the surveying and mapping section of this course, students work together in groups of six to complete the surveying and mapping tasks of components. Before surveying and mapping, during the online teaching stage, teachers assign tasks to guide students to refer to relevant materials, understand the specific uses of the components to be surveyed, and provide a certain basis for subsequent modeling. Record a micro lesson video to explain the key steps of component modeling. The surveying of components is conducted during offline teaching, and after the surveying of components is completed, 3D software is used for modeling. Figure 2 is a two-dimensional view of the transmission box, and Figure 3 is a three-dimensional view. As shown in the figure, the solid model is much easier to understand than a set of two-dimensional static engineering drawings representing the same design. Not only that, creating 3D parameterized solid models can also use a large number of correlation integration tools, such as toolsets that 2D representations cannot use, such as CAE/CAM/PDM. To reduce the cost of the prototype, the strength of the parts can be verified during the design phase, and analysis can be conducted directly through

CAE tools after the completion of 3D modeling. Digital intelligent design is the effective integration of these tools and unified management through PDM. The organic system formed by coordination enables the entire design to be fully digitized, effectively improving design efficiency, reducing design costs, and enhancing design effectiveness[16-17]. Provide a foundation for subsequent course design and graduation project.

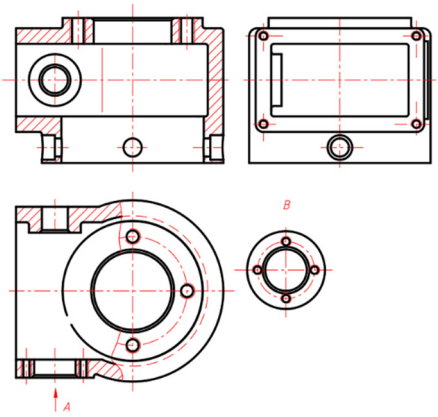

Figure2 Two dimensional diagram of transmission box

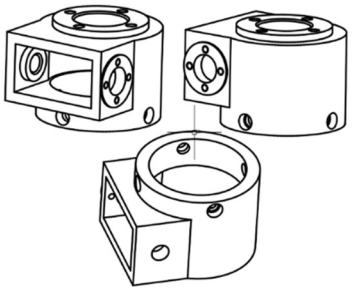

Figure3 Three dimensional diagram of transmission box

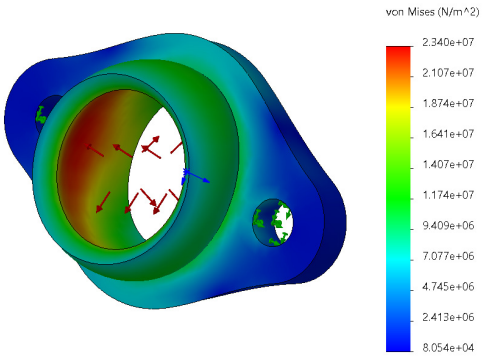

Figure4 Finite element analysis of packing gland

Teachers should actively guide and inspire students to have innovative thinking, which determines their innovative ability. This requires teachers to collect and organize vivid cases during the online teaching stage, record micro lesson videos, and guide students to actively think and explore surveying methods and techniques. In the offline teaching stage, teachers should leave appropriate blank spaces to provide sufficient room for students' innovation ability, guide students to design and propose questions, discuss problems through positive thinking, encourage students to argue and discern, and clarify the root cause of problems. Cultivate students' independent learning and thinking abilities. In traditional mechanical drawing practical courses, students only mechanically complete the learning content of practical courses and express existing components through two-dimensional diagrams. The impact of working conditions on these mechanical components in production practice, as well as how to improve their functionality, is difficult for students to achieve perfect and innovative design without intuitive experience. With the rapid development of computers, parameterized 3D software has been widely used. The first manifestation of digital intelligent design is parameterization. Through parameterization, it is easy to make design changes to products and design a series of products, fully reflecting the designer's design intention. Students trained by schools should keep up with the development of the times and be able to quickly adapt to job positions after graduation. This course uses intelligent design tools to model parts. By inputting operating conditions and conducting finite element analysis, it is easy to test whether the parts meet the strength requirements. The analysis results of the packing gland after adding the operating conditions as shown in Figure 4. In intelligent design software, the weak points of the parts under stress can be directly identified, and recommended optimization methods can be provided by setting optimization objectives.

4 The Reform Effect of Mechanical Drawing Practice Course

From the achievement of course objectives, it can be seen that the overall learning effect of students is good. Be able to correctly refer to national standards and relevant technical manuals for mechanical drawing. Proficient in using commonly used measuring tools and mastering common measurement methods. Capable of using 3D software to model components and generate engineering drawings, with a certain ability to analyze and solve problems, meeting the requirements of course objectives and graduation requirements. Some students have a better grasp of it and can innovate and design some products.

Significant results were achieved in extracurricular competitions. The National College Students Advanced Mapping Technology and Product Information Modeling Innovation Competition, as the Olympic Games in the field of graphics, is receiving increasing attention. Since Dalian Jiaotong University participated in the 13th Mapping Competition in 2020 and achieved certain results, teachers have gradually integrated competition elements into the teaching process of mechanical drawing practical courses. In terms of theoretical knowledge teaching, computer parametric modeling, digital innovative design, etc., teachers focus on cultivating students' thinking ability and innovative initiative. The enthusiasm of students for extracurricular competitions is high, and the number of participants is increasing year by year. Although the students in our school have participated in the competition for a short period of time, they have achieved gratifying results. Over the past four years, teachers have guided students to participate in the mapping competition and won 21 national first prizes, 30 second

prizes, and 4 third prizes. This course applies the teaching method of digital intelligent design to cultivate many students with innovative design abilities. To provide talent for subsequent mechanical design competitions, robot competitions, and engineering training competitions.

5 Conclusion

The practical course of mechanical drawing adopts a blended online and offline teaching mode. Through the reform of course content, the teaching method suitable for the new era talent training plan is redesigned, incorporating cutting-edge industry technologies into the teaching content, and weakening the theoretical nature of course content arrangement; Highlighting practicality; Reflect progressiveness; Cultivate innovation. Introducing a diversified teaching system in the classroom, with digital intelligent design as the theme, integrating actual enterprise products, not only guiding students to model these products using 3D software, but also incorporating working conditions to guide students to analyze the status of products in actual work, improving students' interest and enthusiasm. Students can not only complete the learning content of mechanical drawing practical courses, but more importantly, they can learn the basic concepts of design and integrate these concepts into subsequent courses.

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2. Dalian Jiaotong University Undergraduate Teaching Quality and Education Reform Research Project “Ideological and Political Education in Mechanical Drawing Practice Course”(Project No:djtu23100103019)

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