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Teaching Reform of Mechanical Design Course under the Background of Innovation and Entrepreneurship Education

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Abstract: Mechanical design is an important part of mechanical engineering. It is the first step in mechanical production and the most important factor in determining mechanical properties. Aiming at the problems existing in the current innovation and entrepreneurship education, a practical teaching system aiming at cultivating the innovative and entrepreneurial ability of mechanical design students is constructed. By strengthening the practical teaching link, the theoretical curriculum is closely integrated with the practical operation, and the concept of innovation and entrepreneurship is deeply integrated with professional education to improve students' innovative ability, scientific quality and entrepreneurial practice ability.

1. Introduction

Mechanical design is a professional technical basic course for mechanical majors, and mechanical design curriculum design is a practical part of training students to design general mechanical design capabilities. In the course of course design, students are required to comprehensively apply the pre-requisite mechanical drawing, engineering materials, mechanical principles, material mechanics, metal technology, tolerance and technical measurement to complete the mechanical transmission design independently. Through the implementation of this teaching link, students should be familiar with, familiar with and master the basic methods and steps of mechanical design. From the digestion of a large amount of information and technical data, after repeated thinking, design a reasonable design plan that meets the actual requirements. So that students can establish correct design ideas and rigorous work style, cultivate students' theoretical and practical design ideas, improve the ability to analyze and solve practical problems in engineering, consolidate, deepen and expand the knowledge about mechanical design, which is a comprehensive training for students' practical ability and innovative ability.

2. The Feasibility of Innovation and Entrepreneurship Education in the Design of Mechanical Design Courses

Innovative entrepreneurship education is specific to engineering disciplines such as mechanical majors. It is indispensable to cultivate students' engineering practice ability and innovative design ability through experimental techniques. In the current professional setting of mechanical majors in engineering colleges, the first comprehensive comprehensive practice is the mechanical principle and mechanical design curriculum design. Mechanical design course design is based on the design of mechanical products, through mechanical product demand analysis, design topic selection, mechanical system motion program design, mechanical system structure design, program evaluation and decision-making, computer-aided mechanical system design and analysis, computer aided modeling and simulation, design and technical documentation, and training in the whole process of mechanical product design.

Incorporating innovation and entrepreneurship education into this process, based on the students' comprehensive design ability and computer application ability in engineering practice, the students' innovative design ability, re-learning ability and teamwork spirit can be cultivated. In this way, the teaching objectives and requirements for students to have the basic qualities of college students in the era of entrepreneurial innovation can be achieved.

In order to achieve the goal of innovation and entrepreneurship education, first of all, the functions of teachers and students in practical courses need to be re-divided and designed.

3. Problems in the Design of Mechanical Design Courses

At present, the design of the mechanical design course is mainly based on the design of the reducer. Although the reducer is a typical mechanical component, it basically covers the main content of the mechanical design course, which is beneficial to the students to fully grasp the relevant knowledge. Therefore, the topic of reducer design has been adopted by many colleges and universities as a mechanical design course for mechanical majors. However, the curriculum design has a single topic and the design process is the same. Most students in the design process are mechanical imitation designs, rather than actively thinking. Moreover, the existing information related to the design of the reducer is various. When students are doing the course design, they can easily complete the design task by following the steps in the data, and there is no challenge and freshness for the students. Students are unable to improve their ability to analyze and solve problems during the design process. Therefore, the traditional teaching model of curriculum design can no longer meet the needs of the development of science and technology, and must be reformed accordingly.

4. The Implementation of the Teaching Reform of Mechanical Design Courses under the Background of Innovation and Entrepreneurship Education

4.1. Taking the Competition as the Carrier to Realize the Combination of Professional Course Training and Innovation and Entrepreneurship Competition

Encourage students to apply their professional knowledge to participate in various mechanical innovation design competitions and college students' innovation and entrepreneurship training program. Applying student works to classroom teaching not only solves the problem of lack of teaching aids, but also trains students' innovative consciousness and hands-on ability, fully

embodies the role of innovation and entrepreneurship education in strengthening and promoting professional courses, and achieves the purpose of "promoting practice through competition and promoting teaching through competition". Transform students' achievements and innovative entrepreneurship training programs into curriculum design and graduation design, and realize the integration of innovative entrepreneurship and practical teaching. For example, carbon-free cars, various wheel train teaching models, fitness washing machines, multi-functional seats and other majors of interest to students have been successfully transformed into mechanical design and mechanical design courses. The rolling mill mechanism teaching model, the correcting machine teaching model, and the development of the shearing machine teaching model have been included in the graduation design project. At the same time, the outstanding achievements of the competition have been pushed to the market, allowing students to experience entrepreneurship as early as possible and achieve good results.

4.2.Using the Project as a Means to Optimize the Content of Practical Teaching

Introduce scientific research training into the classroom in the form of special series lectures, so that students can understand the frontiers of mechanical design and the high-end research development at the current stage. The special training session is set up in the lecture, and the research project is decomposed into several sub-topics. The students are grouped as units, and each group is responsible for the research of a sub-topic. In the process of uniting and cooperating to complete the project, the students spontaneously learn professional knowledge, give full play to the individual's creative thinking and innovative ability, expand the students' ideas, and constantly propose more and better solutions. For example, the comprehensive mechanical principle and mechanical design curriculum design requires the manufacture of a vibration-assisted magnetic grinding machine. According to the process of equipment design and debugging, the teacher divides the students into 5 groups, like principle design, virtual simulation, procurement processing, experimental debugging, patent application, etc. The principle design team should figure out the working principle, determine the mechanical composition and optimal configuration of the equipment, and finally design the entire equipment. The virtual simulation group uses Solidworks or Pro/e software to perform 3D solid modeling of the finished 2D equipment drawings, check whether there is interference between the parts, and then simulate the actual working conditions for dynamic simulation, so as to ensure that before the equipment is processed. The error loss is minimized. In the absence of any errors, the procurement processing group purchases the standard common parts required for the equipment according to the requirements of the design team, and then assembles the equipment. The experimental debugging group was commissioned and tested after the equipment was assembled to determine the grinding ability of the machine. Finally, the patent application team formed a written text on the designed grinding machine and applied for a patent in accordance with the relevant requirements of the utility model patent. In the above process, the instructor keeps track of each link, and is truly student-oriented and supplemented by teachers. Through a series of trainings, students' teamwork ability, innovative and entrepreneurial ability are trained and improved, and the teaching effect is much better than the traditional course design mode. In the graduation internship and graduation design session, the instructor will regularly communicate with the students, organize students to go to the company for internships, guide them to participate in project research and development and solve practical problems on the spot, and lay a good foundation for future entrepreneurship and employment.

4.3.Play the Role of Practice Teaching Base inside and Outside the School

The practice teaching base is an important teaching and research place for the university to connect theory with practice and cultivate comprehensive talents. It is an important support for accomplishing the goal of talent training. Make full use of the school machinery innovation laboratory, engineering training center, university science park, key laboratory, and establish cooperative relations with enterprises to build a platform for innovative training and practice for students. The School Engineering Training Center undertakes the practical teaching tasks of undergraduates. Here, students improve their hands-on ability by operating equipment and processing parts. The School Science and Technology Park has established a comprehensive cooperation alliance of “production, learning and research” to attract enterprises and research institutes to provide venues, projects, funds, policies and other support for college students' innovation and entrepreneurship, and to provide students with more opportunities to participate in the application of innovative entrepreneurship projects. In the Science and Technology Park, students participate in entrepreneurial activities through various practical methods such as participating in relevant research projects of teachers, self-employment, and internships in science and technology parks. While completing the daily teaching and research tasks, the school's key laboratories are open to the university students' innovation and entrepreneurship practice base, and provide support for students' innovation and entrepreneurship practice.

5. The Assessment Method of the Teaching Reform of Mechanical Design Courses under the Background of Innovation and Entrepreneurship Education

Assessment is an effective way to identify students' learning effects. However, the traditional closed-end examination method has certain drawbacks. It is easy for students to fall into the misunderstanding and pre-existing psychology of the pre-examination, and it is impossible to conduct scientific examination and assessment of the students' learning process and learning state.

Therefore, some reforms and adjustments have been made to the assessment method. In the form of assessment, the scores are divided into two parts: the usual score and the final grade. The usual grades use a variety of methods such as notes, assignments, tests, training, and project work. Disperse the results in peacetime, increase the intensity of the usual assessment, improve the initiative of learning and learning, and promote students' accumulation of knowledge. At the end of the written test, the closed-book format is used to test students' memory, understanding and mastery of basic knowledge and basic theory. In the design of the topic, the content that reflects the professional characteristics is highlighted, and the application and problem analysis of the professional characteristics are highlighted, so as to examine the students' ability to apply knowledge, and to link the follow-up courses so that the students can experience and understand the profession in depth.

In the assessment, we attach importance to the assessment of students' comprehensive ability. Conduct practical assessments in the on-campus training room and in companies that have established a school-enterprise partnership with the profession. According to the actual scene, combine the actual problems encountered in the future work of the students to set the topic, or take the actual car parts as the assessment content. In the assessment, according to the requirements of the topic, the students conduct hands-on operation, defense, observation and analysis, data calculation, and finally get the results and fill in the assessment records. The professional steering committee composed of department heads, professional leaders, teachers, laboratory directors and industry experts is the evaluation team to conduct a comprehensive, objective and fair evaluation of

the students' achievements. This method of performance evaluation is conducive to students to develop good study habits, to cultivate scientific and reasonable learning methods, to strengthen practice and innovation ability, and is also conducive to teachers summing up, improving teaching methods and improving teaching quality. But in general, the improvement of the assessment method frees the students from the old teaching mode of rote memorization, and guides the students' attention to the flexible application of knowledge, so that students pay attention to the combination of theory and practice. It has a very positive significance for strengthening the cultivation of innovative ability and practical ability.

In order to quantify the evaluation of students' comprehensive ability and make a comprehensive, objective and fair evaluation of students' achievements, this paper designs an evaluation template. The calculation basis of this evaluation template is the weighted summary method, the formula is:

$$A=\sum_{i=1}^{I}\lambda_i[\sum_{j=1}^{m}\lambda_{ij}(\sum_{k=1}^{n}\lambda_{ijk}a_{ijk})] \tag{1}$$

At the same time, when the evaluation method is designed to collect and process information, the weighted sum scoring method is also used to process the collected students' comprehensive performance evaluation information, the formula is:

$$S=\sum_{1}^{n}Q_iS_i(i=1,2,...,n) \tag{2}$$

Among them, A and S are the comprehensive scores, and the indexes are i, j, k. through the analysis and processing of the indexes, the evaluation information data is calculated, and the students' scores are evaluated to understand the students' comprehensive ability.

6. Experimental Research and Analysis on Teaching Reform of Mechanical Design Course under the Background of Innovation and Entrepreneurship Education

6.1. Analysis of Students' Attitude towards Innovation and Entrepreneurship Teaching Reform

Under the background of innovation and entrepreneurship education, the teaching reform of mechanical design course, aiming at the problems existing in the current innovation and entrepreneurship education, constructs a practical teaching system aiming at cultivating the innovation and entrepreneurship ability of mechanical design students. By strengthening the practical teaching link, the theoretical courses are closely combined with the practical operation to improve the students' innovation ability, scientific quality and entrepreneurial practice ability. In this paper, through the way of questionnaire survey, the students' attitude towards innovation and entrepreneurship after the teaching reform is investigated. The results are shown in Table 1.

Table 1. Students' attitude towards teaching reform of mechanical design course

attitude	Very satisfied	satisfied	commonly	dissatisfied	very dissatisfied
proportion	55.73	25.1	12.95	5.97	0.25

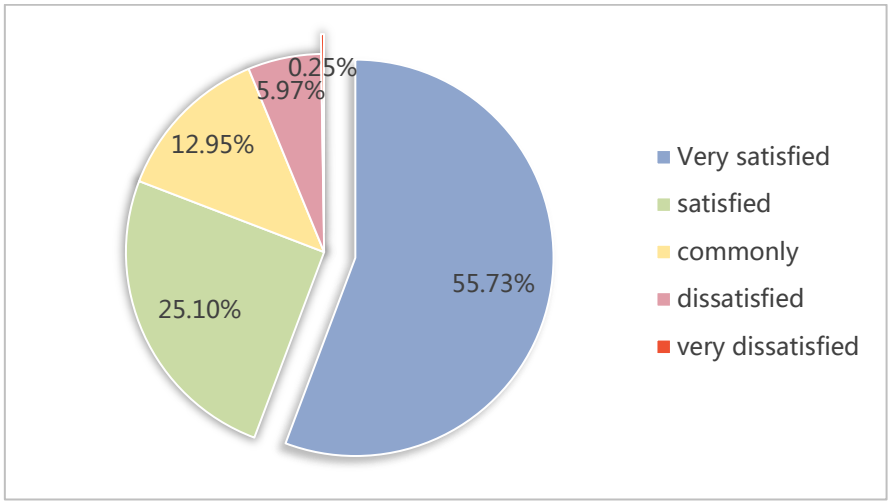

Figure 1. Students' attitude towards teaching reform of mechanical design course

It can be seen from Figure 1 that 80.83% of the students are satisfied with the teaching reform of innovation and entrepreneurship course, 12.95% of the students are not satisfied with the teaching reform of innovation and entrepreneurship course, and 6.22% of the students are not satisfied with the teaching reform of innovation and entrepreneurship course.

6.2. Analysis of Students' Performance before and After the Innovation and Entrepreneurship Course Teaching Reform

The new innovation and entrepreneurship course teaching reform evaluation method has been reformed and adjusted. It pays attention to the evaluation of students' comprehensive ability. The evaluation begins with the usual performance and final performance. Therefore, through data mining technology, this paper selects the average score of five mechanical design teaching reform classes, compares the average score before and after, and the data results are shown in Table 2.

Table 2. Analysis of students' performance before and after the innovation and entrepreneurship course teaching reform

		average
class 1	before	65.53
	after	68.36
class 2	before	67.46
	after	69.97
class 3	before	63.37
	after	67.35
class 4	before	65.87
	after	68.14
class 5	before	65.61
	after	70.03

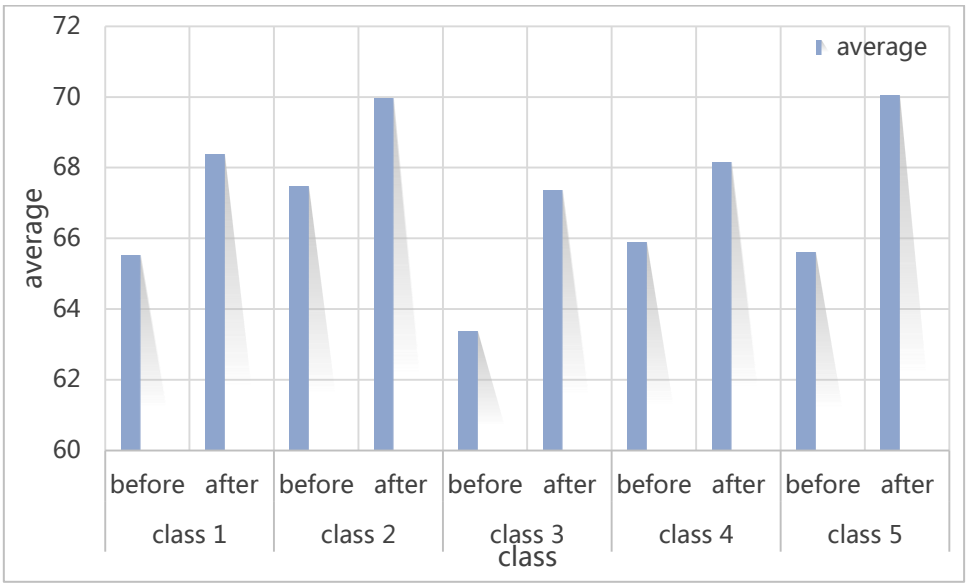

Figure 2. Analysis of students' performance before and after the innovation and entrepreneurship course teaching reform

As can be seen from Figure 2, after the implementation of the evaluation method for the teaching reform of the new innovation and entrepreneurship course, the average score of each class has increased by a small margin. For example, the average score of class one has increased from 65.53 to 68.36, and the average score of class two has increased from 67.46 to 69.97.

7. Summary

In the comprehensive practice of mechanical design curriculum design, students will be educated in innovation and entrepreneurship to help them cultivate innovative thinking, master the necessary methods, disseminate seeds in their hearts how to discover and create, how to create a better environment and more wealth for human beings. Once they meet the right opportunities in the future, they can make full use of their innovative and entrepreneurial skills, use their knowledge to create more productivity, and make more contributions to society. In the reform of mechanical design curriculum design, by reforming the design content to make it closer to the actual project, which can fully mobilize the enthusiasm of students to participate in curriculum design, and cultivate overall design awareness and innovation awareness. Through the application of computer technology, students' ability to use computer technology for mechanical design and simulation analysis has been strengthened. By allowing students to get in touch with engineering practice, students' ability to analyze and solve practical problems in engineering is further enhanced.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this

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Conflict of Interest

The author states that this article has no conflict of interest.

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