

Teaching Reform and Practice of “Interchangeability and Measurement Technology” in the Context of New Engineering

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Abstract

It is to introduce the course characteristics of interchangeability and measurement technology, and the teaching reform is carried out in a targeted manner according to the learning characteristics of the mechanical students of the college, and streamlining the learning content of the course. It is divided into publishing preview content before class, monitoring learning attendance during class, adding discussion and communication links in class, and adding group homework after class. Through the application of some projects of the college, it is to train the scientific research ability of students, and a closed-loop learning system of the curriculum has been formed, which has a significant learning effect for students majoring in mechanical engineering through a period of practice.

Keywords

New Engineering; Talent training; Teaching reform; Interchangeability

Introduction

Under the background of a series of national strategies such as "Made in China 2025" and intelligent manufacturing, it is hoped to transform traditional industries with digitalization, improving product production lines with intelligence, to enhance the comprehensive competitiveness of industrial enterprises, producing more products with high industrial added value, and to brighten the brand of Made in China. The new engineering department is proposed to actively respond to the new round of scientific and technological revolution and industrial transformation, and to support the development of service innovation [1]. New engineering is an important reform direction of national engineering education, which should be guided by and of virtue, to cope with the new situation as the construction concept, and to inherit and innovate, cross and integrate, coordinate and share as the main ways, to

cultivate future diversified, innovative and outstanding engineering talents, so as to meet the new needs of national strategic development and the new requirements of virtue and cultivation [2].

From parts to complete machines, from civilian to military, from the first assembly line to smart factories, the development of the manufacturing industry has always been promoted by the interchangeability and measurement technology. Interchangeability and measurement technology is an important professional basic course of mechanical design, manufacturing and automation, which is the role of a bridge from basic courses to professional course teaching, and is the basis and tool for students to learn professional courses and carry out engineering design. A wide range of topics has been covered by the course, including limits and fits, technical measurement basics, geometric tolerances, surface roughness, tolerances and testing of common parts, and involute cylindrical gear transmission accuracy, etc. This course is the foundation of mechanical drawing, mechanical design, machining and other mechanical related courses, which is very important to learn this course well. However, through the long-term teaching process, it was found that there is low level of the students' classroom activity, and most of the students reported that the knowledge points were obscure. The curriculum system was complex, which was difficult to combine theoretical knowledge with engineering practice. Most of the students cope with the exam by rote memorization, failing to absorb and grasping the essence of the course well. The content of the experimental course is outdated, and there is lagging behind for the course to update for the advanced manufacturing process. The knowledge points cannot be well highlighted, and the experimental equipment is backward and cumbersome to operate with an unguaranteed experimental effect [3]. It is to propose the teaching reform and practical exploration of interchangeability and measurement technology so as to further improve the learning effect of interchangeability and measurement technology courses, combined with the actual teaching situation of independent colleges.

1. Grasp the teaching content of the course

The syllabus of Interchangeability and Measurement Technology is to stipulate a total of 40 class hours, 32 theoretical hours, and 8 laboratory hours. The final exam score is to account for 70% and the usual score for 30%. The selected textbook is interchangeability and measurement technology, edited by Zhang Wei and Fang Jun, Machinery Industry Press, which is based on the new national standard. It has the characteristics of new standards, complete content, and clear illustrations, which is equipped with synchronous MOOC video courses and can be better suitable for sophomore undergraduate students majoring in mechanical engineering. Chapters 1 to 6 are mainly taught, which basically cover a number of standard series in the GPS specification, such as dimensional tolerance, limit and fit, geometric tolerance, surface structure, bearing, thread, etc., for precision design and drawing standard

methods [4].

2. Analysis of students' learning status

My independent college enrolls 2 classes of mechanical majors every year, with about 80 students. The theory class is taken by two classes together, and the laboratory class is held separately. According to this teaching method, students who study seriously and have strong self-control can understand the knowledge points well and the effect is well-recorded when they study this course. However, for students who have an average learning attitude and are usually lazy, they find that the learning effect is average. Many students are not aware of the importance of this interchangeability and measurement technology course, which is necessary to emphasize that the course has a role in connecting the basic courses and professional courses, playing an important role in the goal support of graduation requirements. Before learning interchangeability and measurement techniques, students need to have a basic knowledge of mechanical drawing, and be able to correctly identify standard content such as geometric tolerances and surface structure in drawings. This course is to provide knowledge reserves for subsequent courses such as mold design and graduation design, meeting the professional ability needs of students in mechanical product design, mold design, and other employment positions [5].

3. Redesign of teaching content

According to the 2024 version of the college, 70% of the test scores plus 30% of the usual scores in front of the mechanical professionals of the college are adjusted to 70% of the test scores plus 20% of the usual scores and 10% of the experimental report scores, so that the course content design is more reasonable and reflects the spirit of the new version of the talent training program. The teaching content is Chapters 1 to 5, plus Chapter 6 Tolerances and Fits for Rolling Bearings and Tolerances and Fits for Common Threads. The teaching content is more refined, and the core knowledge is more prominent. The course is organized in three steps. The first step is to release the teaching chapters in advance, and then to upload the synchronous video lesson on the wisdom tree in advance. The video lesson will be the basic knowledge to be talked about in the next class, and the basic knowledge will be briefly explained. The second step is to interact with teachers and students during the class. According to the feedback from the pre-class learning, the focus is on the important and difficult points of teaching, and through interactive activities such as case analysis, knowledge summary, class discussion, and flipped classroom. It helps students strengthen their understanding and comprehensive application of knowledge content. In the third step, after the teaching of knowledge points, a comprehensive practice course on the accuracy design of typical parts will be arranged. Students are divided into groups and the group members collaborate on a design project [6].

4. Reform teaching methods

With the help of the development of the Internet, education informatization has been popularized. It is to establish a flipped classroom of interchangeability and measurement technology on the Wisdom Tree platform, uploading learning courseware and learning explanation videos, and to complete the online course. Before each class, it is to use the sign-in function of Wisdom Tree to dictate gestures before class, and students log in with their mobile phones and enter specific gestures to complete the sign-in.

The students' attendance rate can be checked so as to find out who did not come to class at a glance. In offline classes, students use synchronous courseware to explain the core knowledge points, and their understanding ability is significantly improved after listening to the teacher's explanation. Each class has a discussion session, the purpose of which is to guide students to ask their own questions, whether the problem is individual or common to most students. The teacher will explain the same-sex problem again until the students understand it. Through class discussions, exercise releases, flipped classrooms, in-class tests, real-time evaluations, etc., students can understand their knowledge mastery in a timely manner, so as to realize the dual-master interaction, multi-dimensional connection and record between teachers and students. Every 10 class hours, a group assignment will be assigned, which requires students to combine what they have learned, discussing with the group members, and finally to summarize it to form a group assignment, which will be handed in and reviewed by the teachers.

5. Combine curriculum teaching reform with students' scientific research training

In the second semester of the sophomore year, when taking the course of interchangeability and measurement technology, students have already learned mechanical engineering materials, and have a deeper understanding of the processing of common metal materials. This year, focus will be on the students who were serious in class, and selected 2 groups, each group being designated a small group leader, so that students could complete the application for college students' innovation and entrepreneurship projects around the mechanical professional knowledge they learned and according to the requirements of the application form. After the students' literature collection and sorting, discussion and exchange with the lecturers, and the two groups under the guidance of the students, it was successfully to establish the innovation and entrepreneurship project of the college. Some undergraduate students' papers are officially published in domestic academic journals as the first author. Through participating in the scientific research practice in the education reform, the students were deeply touched and realized that their learning and scientific research ability had been greatly improved, and their self-confidence was greater than before, and the teaching reform had brought them an improvement in

quality and an enhancement of their competitiveness in the future [7].

Conclusion

Interchangeability and measurement technology after this reform, the students' learning enthusiasm and autonomy have also been improved. Interchangeability and measurement technology courses from the focus on teaching to focus on the cultivation of students' ability. It is to pay attention to the connection between mechanical knowledge theory and practice, and in the college students' scientific research projects, science and technology competitions, patent inventions have also been made a large number of scientific and technological innovation achievements. The quality and ability of students are generally enhanced, and the quality of graduates is improved. The employment rate of mechanical engineering graduates are more than 98%, and the employment rate is in the forefront of similar universities.

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References

- [1] Chen Feng, Wang Jinping. Ideological and political exploration of interchangeability and measurement technology course under the background of new engineering[J]. Modern Commerce & Trade Industry, 2023, 44(18): 222-224.
- [2] Wang Zhiyong, Yu Shuiqin, Li Wenqiang. Research and practice on the teaching reform of interchangeability and technology measurement in the context of new engineering[J]. China Educational Technology and Equipment, 2024(06): 98-101.
- [3] Yang Lei, Wang Shiqiang, Zhao Yabin, et al. Teaching Reform and Exploration of the Course of Interchangeability and Fundamentals of Technical Measurement[J]. Science & Technology Wind, 2021(20): 2.
- [4] Zhang Wei, Fang Jun. Interchangeability and technical measurement[M]. China Machine Press, 2020.
- [5] Ni Zhiyong. Exploration on the reform of online and offline blended teaching of interchangeability and technical measurement[J]. Agricultural Machinery Use and Maintenance, 2023(7): 153-156.
- [6] Ma Aiqin, Ding Daicun, Li Wei. Exploration of sticky teaching in interchangeability and technology measurement course[J]. China Modern Educational Equipment, 2023(19): 134-136.
- [7] Bo Ping, Wu Meixian, Li Ping, et al. Practice and exploration of interchangeability and technical measurement course education reform[J]. Mechanical Management Development, 2013(03): 128-129.