Exploration of Problems and Countermeasures in Mechanical Principle Course Teaching

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Abstract. As an important professional foundation course for mechanical engineer, mechanical principle is offered in order to let students master basic theory and improve abilities to apply principles and methods to engineering practice. A lot of contents in mechanical principle course are highly theoretical and practical, which have brought many problems to actual teaching. For improving the quality of teaching and meeting the requirement of engineering education professional certification, this paper analyzes the existed main problems and presents the corresponding countermeasures. The countermeasures include teaching form, mode and student score evaluating method.

1. Introduction

Mechanical principle is based on mathematics, physics, mechanics and mechanical drawing. The main contents are the basic theory of mechanism and methods of analyzing and designing common mechanism. The main research objects include four-bar mechanism, cam mechanism, gear mechanism and other motion mechanism, which are close to production practice. Different from common professional courses, mechanical principle focuses machinery's common regularity and is a strong theoretical course. By studying the course, students can master basic knowledge of mechanism and further improve the innovative ability [1].

2. Existing problems in mechanical principle course teaching

There are many big or small problems existing in mechanical principle course teaching. They can be mainly summed up to teaching mode, ideas, methods and cooperation with practice. The following contents will introduce them in detail.

2.1 Traditional teaching mode

In general, the traditional teaching mode that teachers have full lecture and students have passive lectures is still implemented in the most class. Taking course contents as guidance, teachers' teaching runs through from beginning to end of class time. Teachers are the center of class. However, the mode of engineering education professional certification takes study goal as guidance and center on students. In teaching quality improvement, traditional teaching mode mainly depends on teachers, textbooks, and teaching methods. The mode of engineering education professional certification has quality guarantee system of continuous improvement, which is the future development direction of mechanical engineer [2]. It is very necessary to improve the traditional teaching mode to meet increasing teaching requirement of high education.

2.2 Rigescent teaching ideas and methods

Many contents of mechanical principle changed little. For many teachers, mature teaching ideas are adopted in most cases, which are often good at imparting knowledge to students but bad at training innovative thinking and ability. However, with the rapid development of teaching theory and high education, a lot of teaching ideas can hardly adapt themselves to current mechanical engineer

teaching. Besides that, teachers often lack necessary encouragement and support to research advanced teaching ideas and take effective measure to reform current rigescent teaching ideas. In teaching methods, teachers aim to let students understand and remember the knowledge in textbooks. So scripted teaching methods are mostly used in class, which makes students feel the content are more abstract and boring. And the lack of interactivity and communication between teachers and students aggravates students' passive study motivation [3].

2.3 Disjointed classroom learning and practice

Classroom learning has the most important role and most amount of time in mechanical principle course teaching. In class, it is difficult for teachers to combine new knowledge of mechanical engineer and teaching, such as new structure and new equipment. Practical teaching in mechanical principle mainly includes experiment and curriculum design. Little chance and time is given to practical teaching. And the practical teaching is often independent of classroom teaching. Experiment and classroom teaching are not synchronous on schedules sometimes and are lack of good cooperation [4]. Curriculum design is usually arranged in the end of term and lasts only a week. But in this week, students have many exams and can hardly spend enough time and energy on curriculum design. Besides that, topics of curriculum design are often similar and lack of variety. All these cause classroom learning and practice disjointed and affect teaching effect [5].

3. Countermeasures to solve existing problems

Through studying the mechanical principle course, students are expected to not only master some basic knowledge but also improve the abilities of innovation, communication and thinking. In this section, corresponding to the above problems, three countermeasures are presented in order to mitigate and solve the problems. The details are as following.

3.1 Vivid, visual and interesting teaching mode

Before classroom teaching, teachers should do research into the content and apply object teaching, multimedia teaching and computer assisted teaching comprehensively [6,7]. For example, the dynamic simulation of mechanism motion can be shown by three-dimension cartoon, and abstract concept can be explained vivid by video. Application of various means creates exciting environment in the class and increases quantity of attractive information, which can heighten the students' study interests and the teaching quality as well. Besides that, some novel, interesting and innovative cases of mechanical structure should also be introduced to students in class [8]. Teachers should encourage students to research the cases and propose improvement plans, which can train students' innovative ability.

3.2 Problem-based learning teaching model

Before the end of classroom teaching, teachers give problems about main content of the next class. Students prepare solutions for the problems by group or themselves. Every student is required to search references, study necessary knowledge and discuss with each other. And complete solutions are provided before the next class. In class, teachers firstly guide students to show the understanding of problems, compare and think the difference between groups, discuss the advantages and disadvantages of their solutions and perfect solutions. And then some excellent solutions can be shown and explained by students. Centered on problems and students, the problem-based learning and teaching model gives students abundant opportunities of thinking and expression, which actives classroom atmosphere and stimulates the students' study interest. Students' abilities of independent study, communication and thinking can also get good exercise and enhancement.

3.3 Student score evaluating method

In order to guarantee the teaching quality and make students follow teachers' guidance, a fair and efficient score evaluating method is crucial. Students' score is decided by three parts, class performance, exam score and practice performance. Class performance mainly is used to judge

students' listening attention and the quality of problem solution, which is recorded in teaching manuals in every class [9]. Strict classroom discipline should be maintained from beginning to end. Some necessary ways are adopted for the students who violate discipline. As the most important score judgment in traditional evaluating method, exam score also plays an irreplaceable role. By the paper exam, students are checked to what extent all basic knowledge is mastered. The questions of the exam should cover all important knowledge, which makes students have sufficient competition pressure and motivation to learn the daily content well for higher score. In practice performance, experiment should be arranged coordinated with classroom teaching in time and content. Students are asked to finish the experiment process and submit report. Their attention and quality decide the experiment score.

4. Summary

Mechanical principle is one of the most basic and important courses in mechanical specialty. However, present teaching quality is not satisfactory and declines gradually. Traditional teaching mode and methods make classroom teaching hard to attract students' attention and passion. Compared with some advanced courses such as compute aid design and numerical control machining, the content of mechanical principle has less variations, which aggravates the situation more or less. In order to improve the teaching quality of mechanical principle, this paper points out the main problems and presents countermeasures. The countermeasures have been applied in mechanism design, manufacturing and automatization in Suzhou University of Science and Technology. During the process of practice, teachers and students generally reflect study atmosphere in class becomes better. And more time and energy are spent on study outside the classroom. The final scores are significantly higher than before. In the future work, more and better countermeasures are still improved continuously.

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References

[1] J. Y. Wei, X. Y. Li, H. X. Wang, and J. Zhen, Exploration of mechanical principle course teaching reform based on innovation capacity training, *University Education*, No. 4, pp. 160-161, 2015. (In Chinese)

[2] Y. M. Wang and X. L. Qi, Reform of mechanical majors curriculum system based on engineering education accreditation standards, *Education Teaching Forum*, No. 15, pp. 124-125, 2019. (In Chinese)

[3] C. X. Chen, Y. Mao, and T. M. Zhou, Reflection and practice of the assessment methods of the course of theory of machines and mechanisms, *Education Teaching Forum*, No. 48, pp. 161-162, 2016. (In Chinese)

[4] H. L. Guo, L. X. Zhang, J. C. Zhang, and L. X. Hou, Reform thought exploration of course experiment teaching, *Education Teaching Forum*, No. 1, pp. 164-165, 2016. (In Chinese)

[5] Z. H. Sun, H. B. Shan, Y. M. Zhuang, and Z. M. Gao, Improving the innovative ability of students and reform mechanical principle curriculum design, *Research and Exploration in Laboratory*, vol. 26, No. 11, pp. 98-99, 2007. (In Chinese)

[6] W. Zhang, Application practice of virtual prototype technique in mechanical principle teaching, *China Electric Power Education*, No. 2, pp.152-153, 2014. (In Chinese)

[7] H. L. Guo, L. X. Zhang, J. C. Zhang, and L. X. Hou, Reform exploration of mechanical principle course teaching system, *Higher Agricultural Education*, No. 6, pp.59-60, 2011. (In Chinese)

[8] J. Hua, C. X. Zhou, and X. M. Yuan, Research on mechanical principle teaching based on engineering ability training, *Theory and Practice of Contemporary Education*, vol. 6, No. 9, pp. 51-52, 2014. (In Chinese)

[9] G. Z. Tian, B. C. Li, H. G. Zhou, and C. J. Li, Reform and practice of mechanical principle evaluating method based on CDIO, *University Education*, No. 8, pp. 138-139, 2015. (In Chinese)