

Reform and Exploration Mechanical Design Basis Course under the Training Goal of Excellent Engineers

Huiping Guo^a, Lin Zhu^{b,*}

College of Mechanical and Electronic Engineering, Northwest A&F University, Yangling
712100, Shaanxi, China

^aimghp@163.com, ^bzhulin@china.com.cn

Abstract: According to the “Excellent Engineers” talent training plan and objectives and with the cultivation of innovative and practical talents as the aim, the paper combines the features of the content of the non-mechanical course called Mechanical Design Basis to analyze problems the school has when it comes to the teaching of this course. Then, the paper maintains that different non-mechanical majors should have their own characteristics in the aspect of course teaching and instruction in the practical link. In the end, the paper comes up with detailed suggestions about the direction and content of reform and exploration from aspects like teaching content, teaching methods, practical teaching etc., which is of practical significance to the instruction of this course.

Keywords: Excellent Engineers, Mechanical Design Basis, Reform and Exploration

1. INTRODUCTION

At present, higher institutions in China attach importance to training students' basic theoretical abilities without paying enough attention to the cultivation of their practical and innovative capabilities. As a consequence, Chinese students universally lack practical abilities. With the development of China's construction of modern economy, it is far from enough for students to be only equipped with solid theoretical knowledge. More importantly, they are supposed to have relatively strong practical abilities. Only in this way can they meet the requirements of the society and have international competitiveness. To solve the currently inharmonious relationship between Chinese higher institutions' pattern of cultivating students and the actual social demand, Ministry of Education of the PRC successively held 3 seminars in October 2009 and confirmed the implementation of “the Plan to Educate and Train Excellent Engineers” [1]. In June 2010, Ministry of Education issued the *Notice on Approving the First Batch of Higher Institutions to Carry out “the Plan to Educate and Train Excellent Engineers”*, approving 61 higher institutions such as Tsinghua University etc. as the first batch of higher institutions to

implement “the Plan to Educate and Train Excellent Engineers”, which ushers in a new chapter for the engineering education history of China [2]. As pointed out by the document, “Excellent Engineers” should be equipped with the basic qualities of new engineers in the 21st century, including [3]: 1) Super strong ability of engineering analysis; 2) Relatively good practical ability; 3) Strong consciousness of innovation and design ability; 4) A comparatively high level of professional quality and ethical and moral standard; 5) Good ability to apply and update knowledge; 6) Perseverant learning ability; 7) Strong business and management skills; 8) Required leadership skills; 9) Adequate communicative skills. According to the overall goals of reform and development set by the “12th Five-year Plan” and the spirit to comprehensively promote *Suggestions of Northwest Agriculture and Forestry University on Further Deepening Educational Reform and Improving the Quality of Undergraduate Talents*, our school also requires to establish the mechanism of “the Plan to Educate and Train Excellent Engineers” in the training program (new version for 2014) for engineering majors so as to further facilitate the plan to train innovative and practical talents and improve the quality of talent training.

The “Excellent Engineers” talent training plan provides clear talent training goals for many practical majors. Such kind of training concept should be effectively applied in the process of course teaching especially the teaching of courses with strong practicality as well as reflected in the policy to train professional talents. *Mechanical Design Basis* is exactly a course with strong comprehensiveness and practicality. As an important basic course for mechanical majors, *Mechanical Design Basis* is also a course that comprehensively applies relevant knowledge like mechanics of materials, theoretical mechanics, engineering materials, mechanical drawing, mechanical principle, mechanical design etc. The course is not only strongly theoretical but also is closely combined with practice. Thus, it plays a significant role in cultivating students’ innovative ability and the capability to solve problems in production and practice [4]. Therefore, with the “Excellent Engineers” plan as the guidance, it is of important practical significance to realize the teaching reform and exploration of this course.

2. THE CURRENT SITUATION AND PROBLEMS OF THE COURSE TEACHING OF MECHANICAL DESIGN BASIS

At present, majors in our school that have set up the course *Mechanical Design Basis* include Wood Science and Engineering (Furniture and House Design), Food Science and Engineering, Thermal Energy and Power Engineering etc. During the process of course teaching, members in the research group have been constantly completing the teaching system, enriching the teaching content and making innovative efforts in the practical link, and have made corresponding achievements in the educational reform and practice. However, when it comes to the core content of the “Excellent Engineers” plan, that is, to cultivate students’ practical ability, innovative consciousness and innovative designing ability, the course teaching still has the following problems:

(1) Course Content

The course content is not innovative enough and the teaching content lays particular stress on theoretical derivation without arranging the theoretical teaching according to the purpose of cultivating students' innovative and practical ability required by the plan. And there are certain differences between the current course content and the course content or knowledge points required by the practical production. The setting of the course content is not scientific enough. The textbook and curriculum cases used by non-mechanical majors are all the same without reflecting the differences this course should have for different majors while being applied in the production practice.

(2) Teaching Method

The traditional teaching method of this course is not diversified enough. The course teaching is only about the explanation of theoretical knowledge without combining teaching with practical engineering cases, which is unfavorable for students to bring their learning initiative into full play. As a result, students universally lack the ability to solve practical problems using what they've learned. As for the mode of instruction, the students are like ducks being force-fed by the teacher who keeps pouring knowledge into them without caring about whether they've actually learned something or not. There's no effective communication between the students and the teacher. In addition, most students complete their curriculum design tasks alone by themselves. There are few opportunities for them to cooperate with each other in doing product design, research and development. Communication and cooperation between students are absent as well.

(3) Practical Teaching

As an important link of practical teaching in the curriculum system of mechanical design, *Mechanical Design Basis Curriculum Design* is the first comprehensive engineering design training that is relatively comprehensive and systematic. Speed reducer has been the theme of *Mechanical Design Basis Curriculum Design* of our school for a long time. Every year, students from different majors are working on the same design theme repeatedly, which will definitely affect their enthusiasm in design [5-7]. Apparently, the traditional course *Mechanical Design Basis* does not go hand in hand with the objectives of the "Excellent Engineers" talent training plan in the aspect of teaching content, method and practical teaching. Therefore, the teaching reform is imperative.

3. REFORM AND EXPLORATION OF *MECHANICAL DESIGN BASIS*

3.1 Research Orientation

In order to reflect the objectives of the "Excellent Engineers" training plan to cultivate application-oriented undergraduate talents with adequate practical ability and innovative design ideas, based on the current situation about the teaching of *Mechanical Design Basis* in our school and the requirements of the "Excellent Engineers" training plan, the teaching reform

and exploration should be carried out from the following perspectives, namely teaching content, teaching method, practical teaching etc.

(1) Optimizing the Teaching Content

According to the requirements of the “Excellent Engineers” training plan, corresponding curriculum systems should be established; more teaching contents related to students’ majors should be integrated into the curriculum systems based on the demands of different majors with “improving students’ innovative and practical ability” as the objective; importance should be attached to cultivate students’ ability of creative thinking in their professional fields.

(2) Improving the Teaching Method

The current situation where the teacher plays the dominant role during the teaching process should be changed. It is necessary to stimulate the initiative of students and fully mobilize their learning enthusiasm. Instead of force-feeding students with theoretical knowledge, the teacher is supposed to guide students to take the initiative to construct knowledge. The teacher should get students fully involved in classroom teaching and try to create opportunities for teacher-student and student-student dialogue rather than just present a monologue in class.

(3) Making the Practical Teaching More Innovative

Practical teaching should combine theories with the production practice, innovative design, research and development of products in the industry. As for the curriculum design part in the link of practical teaching, more diversified design themes should be added. Emphasis is supposed to be laid on the cultivation of students’ creative design ability and practical ability.

(4) Evaluating the Teaching Effect

According to the teaching objectives of this course, an effective teaching effect evaluation system and result feedback mechanism should be established to timely obtain information about effects of the teaching reform.

3.2 Research Objectives

With the “Excellent Engineers” training plan as the goal, the research aims to optimize the teaching content, enrich the teaching methods, improve the practical teaching link and increase the teaching effect of the whole course. The paper aims at exploring a teaching method that can stimulate students’ potential of independent learning and innovation during the process of giving classes to students from different majors and providing more reasonable course teaching systems and methods for the cultivation of excellent talents with strong innovative and practical abilities.

3.3 Methods

(1) Optimizing the Course Content

Product case analysis should be integrated into the teaching content. Relevant mechanical principles and design theories should be explained based on product functions. Product cases

that use the same organization to realize different functions ought to be classified and analyzed. As for the cultivation of students' innovative ability, based on the demands of students from different majors attending this course, advanced innovative methods at home and abroad such as the TRIZ theory (Theory of Inventive Problem Solving), system analysis, optimal choice etc. should be introduced to provoke students' ability of creative thinking.

(2) Course Teaching Method

When it comes to strengthening students' awareness of innovation and practice, case-based teaching should be applied to analyze and learn the innovative points of outstanding cases and profoundly understand the uniqueness and practicality of design methods adopted by those cases. To improve students' learning initiative, the interactive teaching method based on discussion can be used to warm up the classroom climate, enhance students' comprehension of the knowledge taught in class, improve their learning interests and strengthen their teamwork awareness.

(3) The Link of Practical Teaching

As for the curriculum design in the practical teaching link, various competitions such as the National Undergraduate Mechanical Innovation Design Competition, the National Mechanical Product Digital Design Competition, the Red Dot Design Award, the IF Design Award, the "Challenge Cup" Design Competition etc. can be taken as one of the topics for curriculum design. Product design projects directed or participated by the course teacher can also be regarded as one of the topics to encourage students to work in teams to complete the curriculum design.

4. CONCLUSION

As a talent training plan jointly carried out by the Ministry of Education of the PRC and the Chinese Academy of Engineering, the "Excellent Engineers" plan is an important guideline that aims to cultivate innovative talents and engineering talents who meet the needs of economic and social development. Guided by this plan, our school has been constantly deepening educational reform practice. The teaching reform and exploration of this course is a bold attempt of the "Excellent Engineers" plan. It puts forward the methods and ideas to improve the teaching content, the teaching methods and the practical teaching link, which is feasible as well as practically meaningful.

ACKNOWLEDGEMENTS

This work was supported by Northwest A&F University under Grant JY1502019.

REFERENCES

- [1] Yongdong Wang, “Reflections on the Teaching of Inorganic Chemistry Course under the Training Goal of Excellent Engineers”, *Journal of Dongguan University of Technology*, 2011, Vol.18 (5), p114-116.
- [2] Higher Education Division of Ministry of Education. Improving the Quality, Developing the Content: The Conference Document Compilation of Comprehensive Improving Higher Education Quality Work, Higher Education Press, 2012, Beijing, China.
- [3] National Academies Press, *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*, Washington DC: The National Academies Press, 2005.
- [4] Yang Kezheng, Cheng Guangyun, Li Zhongsheng, *Mechanical Design Basics (The Sixth Edition)*, Higher Education Press, 2013, Beijing, China.
- [5] Songbaoyu, *Guide Book of Mechanical Design Course Design*, Higher Education Press, 2006, Beijing, China.
- [6] Wu Zongze, Luo Shengguo, *Design Manual of Mechanical Design Course*, Higher Education Press, 2004, Beijing, China.
- [7] Gong Guiyi, *Design Drawings of Mechanical Design Course (The Third Edition)*, Higher Education Press, 1989, Beijing, China.