

Research on Digital Case Teaching Mode of Mechanical Design Basic Course for Emerging Engineering

Yijie Zhang^{1, a}, Jie Shi^{1, b}, Shengsong Gao^{1, c} and Lingqiong Kong^{2, d, *}

¹College of Mechanical and Electrical Engineering, Yunnan Agricultural University, Kunming 650201, China;

² College of Water Resources and Hydraulic Engineering, Kunming 650201, China.

^azhangyijiekg@126.com, ^b562525920@qq.com, ^c164841349@qq.com, ^{d, *}klqmm@163.com

Abstract. Under the background of the rapid development of new economy in our country, how to train new engineering innovative talents more effectively is an important issue to be solved urgently in higher engineering education. Under the guidance of the innovative educational idea of "Emerging Engineering", this paper faces the goal of cultivating talents of engineering specialty in agricultural colleges and universities, and takes the basic course system of mechanical design as the object of teaching design. This paper probes into a case teaching mode which can effectively improve the comprehensive engineering design ability and innovative consciousness of college students. The teaching mode is based on the digital design platform which condenses the modern design idea and the modern engineering idea represented by Adams, SolidWorks and UG, and integrates the typical engineering design cases into the basic theory teaching of mechanical design. The purpose of this teaching mode is to consolidate students' basic knowledge of mechanical design, to improve students' ability to solve engineering design problems by using digital design software, and to enhance students' innovative consciousness and ability in the process of mechanical product design.

Keywords: Emerging engineering; Teaching mode; Mechanical design basic; Agricultural colleges.

1. Introduction

All In order to support the rapid development of the new economy and cultivate new engineering innovative talents, higher engineering education needs to inject new educational concepts, new educational models and new educational mechanisms. A series of educational reforms led by the thought of "emerging engineering" are called the "new revolution" of engineering education in China. The "emerging engineering" can be expressed as "engineering +", that is, "engineering + new concept", "engineering + new specialty", "engineering + new mode" and other new engineering forms[1-2].The educational concept of "emerging engineering" emphasizes the integrity and integration of each teaching link, and emphasizes that students not only have professional knowledge and technical ability to solve practical engineering problems, but also have a global vision, humanistic spirit and innovative ability. Under the background of the construction of "emerging engineering", how to carry out the curriculum reform of engineering education in combination with the characteristics of running schools, and how to use the advanced digital platform to assist the teaching reform of the course, it is an important subject faced by the teachers of each of our professional and technical basic courses.

At present, no matter scientific research or product development is more and more inseparable from the support of digital software tools, virtual design and simulation under the software environment has become an indispensable link in the whole product cycle. Learning and mastering a variety of related virtual design and simulation software has become a necessary ability of practitioners in the field of engineering [3]. The virtual design and dynamic simulation case teaching based on professional characteristics will more effectively stimulate students' interest in learning and obtain better teaching results.

Combined with the characteristics of agricultural specialty, the College of Mechanical and Electrical Engineering of Yunnan Agricultural University has carried out a series of teaching research on the organic integration of theoretical and practical links based on digital platform (AutoCAD, SolidWorks, Adams and UG, etc.) in the main courses of mechanical design basic and other

mechanical technology[4-6]. Taking the basic course of mechanical design as the object, this paper probes into the new theoretical teaching mode with the help of digital design platform and the integration of classical engineering design cases.

2. Design of Teaching Mode

The basic course of mechanical design contains two important teaching contents, namely, "Mechanical principles" and "Mechanical Design". In the actual teaching process, students generally reflect that the course of mechanical principles is obscure and boring, and it is difficult to stimulate students' enthusiasm for learning and innovative potential. In order to solve the above problems, the teaching mode design of each teaching link in the basic course of mechanical design is redesigned (see fig. 1).

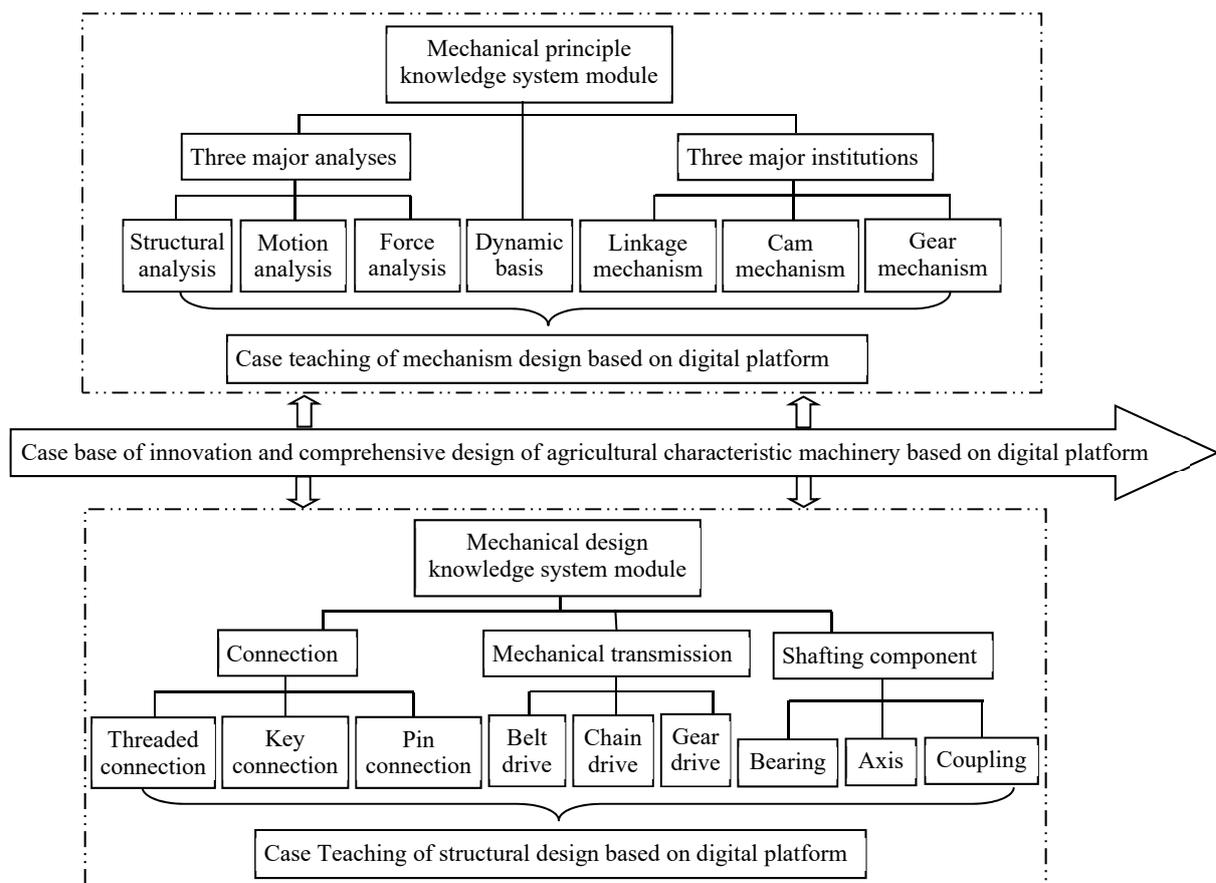


Fig. 1 Design block diagram of teaching mode for basic course of mechanical design

The essence of the design of the teaching mode lies in how to open the internal knowledge vein of each teaching module with the help of digital platform and how to construct the systematic knowledge system of the full integration of each teaching module.

3. The Implementation of Teaching Mode

3.1 Teaching Planning and Achieving Goals

Combined with the teaching reform goal of the certification of mechanical specialty in our college, the implementation of the teaching mode is planned in detail, as shown in Table 1:

Table 1. Teaching planning and objectives

Content of courses		Case unit (class schedule)	Graduation requirements (professional certification indicator point)
Knowledge system of mechanical principle	Three major analyses (structure, motion, and force)	3 cases (3 hours)	1) Be able to reflect the sense of innovation in the design scheme, and make a comprehensive evaluation of the scheme; 2) Be able to use the appropriate tools and technology to select the mechanical design scheme, and understand the limitations of the choice;
	Dynamic basis	1 case (1 hour)	3) Through the study and training of specialized courses, able to carry out mechanical engineering design.
	Three main mechanisms (connecting rod, cam and gear)	2 case (2 hours)	
Knowledge system of mechanical design	Connection	1 case (1 hour)	1) Be able to provide different design schemes for mechanical engineering practice, and take into account social, economic, environmental and other comprehensive factors to optimize;
	Mechanical transmission	1 case (2 hours)	2) Be able to use appropriate tools and technologies to choose mechanical design schemes, and understand the limitations of choice.
	Shafting component	1 case (1 hour)	

3.2 A Case of the Implementation Method of Teaching Mode

Six typical cases based on digital design software are designed in the knowledge system of mechanical principle (see table 1). The teaching cases come from the extraction of scientific research projects [7-8]. For example, the scientific research project entitled "Study on simulation analysis and dynamic performance optimization of seedling planting process of pepper transplanting mechanism" extracted three case modules (see fig. 2). Among them, the first unit is the analysis unit of seedling planting mechanism, that is, the analysis of structure, motion and force, the unit arranges three independent cases, each case aims at one analysis type; The second unit is the dynamic analysis unit of machine seedling planting process, this unit arranges a separate case; The third unit is the mechanism comprehensive analysis unit of the pepper transplanter, which covers three major mechanisms (connecting rod, cam and gear mechanism).

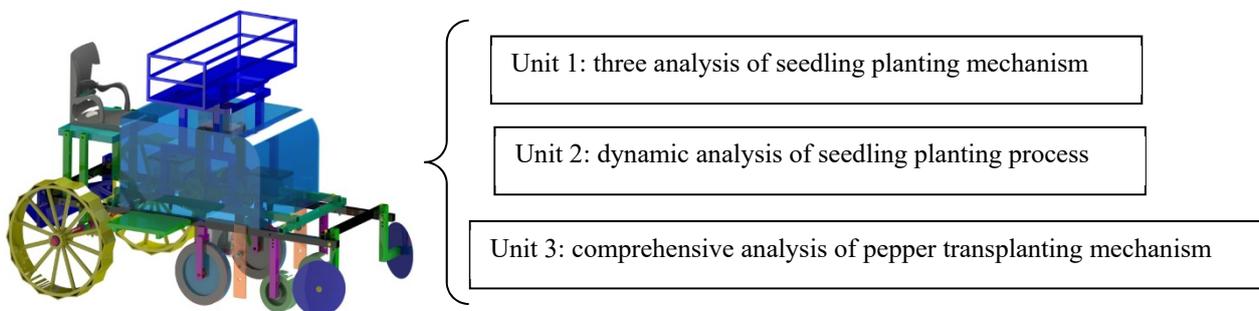


Fig.2 Schematic diagram of case unit of pepper transplanter based on digital design software

The overall design idea of the three case units in fig. 2 is that units 1 and 2 are assisted by real, subject-specific scientific research cases, for example, based on the background of adaptive engineering of pepper transplanting machinery in Qiubei area of Yunnan [8], the key goal is to master the basic theory knowledge. At this time, different institutions can be analyzed separately when the case is explained. Unit 3 is to solve an engineering problem with the characteristics of the subject as the starting point, the mechanical principle of each teaching link is organically linked, emphasizing the integrity and systematic case analysis. It can be said that through the phased case unit teaching in a single course, it is a step-by-step process from mastering professional knowledge to enhancing the ability of engineering analysis.

4. Summary

"Engineering + New Mode" is a new requirement for engineering education put forward by the "Emerging Engineering". The reform of engineering education should always be oriented to

engineering practice, and the teaching mode of engineering education suitable for the professional characteristics of local colleges and universities should be explored from the point of view of national conditions and school conditions. The main characteristics of the case teaching mode based on digital design platform explored in this paper are as follows: (1) It is helpful to expand the students' vision by closely surrounding the real engineering cases. (2) While perfecting the students' knowledge structure, fully guide the students to integrate the modern design method with the digital design means (CAD/CAE), and improve students' comprehensive design ability; (3) Emphasize the students as the main body of autonomous learning and independent tackling key problems, exercise students' ability to solve practical engineering problems independently. In a word, under the wave of new engineering education reform advocated by the new period, it is necessary to implant a new mode of personnel training, that is, to construct a new model of the new engineering curriculum system. The teaching mode studied in this paper has a good reference value for the teaching of the mechanical design basic course.

Acknowledgements

This research was supported by Education and Teaching Reform Research Project of Yunnan Agricultural University [grant no.2017YAUJY065] and Yunnan Tobacco Company Science and Technology Plan Project [grant no.2018530000241010].

References

- [1]. Li Hua, Hu Na, You Zhengsheng. New Engineering Disciplines: The Form, Connotations and Direction[J]. *Journal of Higher Education*, 2017(4):16-19,57.
- [2]. Gu Peihua. The Concept, Framework and Implement Approaches of Emerging Engineering Education (3E) and the New Paradigm[J]. *Journal of Higher Education*, 2017(06):1-13.
- [3]. Yu Jingjun, Guo Weidong, Chen Diansheng. Study on STEP Education Mode Oriented to Engineering Education[J]. *Journal of Higher Education*, 2017(4):73-77.
- [4]. Zhang Yijie, Kong Lingqiong, Shi Jie, et al. Exploration and research in new mode of course design on theory of machines and mechanisms based on UG[J]. *China Modern Educational Equipment*, 2013(3):70-72.
- [5]. Zhang Yijie, Kong Lingqiong, Shi Jie, et al. Graduation Project Quality Optimization of the Vehicle Engineering Based on the Technology of CAD/CAE[J]. *Journal of Yunnan Agricultural University*, 2013(1):72-76.
- [6]. Zhang Yijie, Kong Lingqiong, Shi Jie, et al. Application Research on SolidWorks of Machine Design Foundation Course System[J]. *Journal of Yunnan Agricultural University*, 2014(1): 67-71.
- [7]. Zhang Yijie, Yu Yang, Kong Lingqiong, Zhang Xi, Hu Hongchao, Shi Jie. Motion force analysis and simulation of dry-cured ham during knead processing [J]. *Transactions of the Chinese Society of Agricultural Engineering (Transactions of the CSAE)*,2016,32(10):296-302. (in Chinese with English abstract).
- [8]. Zhang Yijie, Kong Lingqiong, Shi Jie. The Finite Element Structure Analysis and Optimization of Furrow Opener of Pepper Transplanter [J]. *Modern Agricultural Science and Technology*, 2017(1):44-46.