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Exploration of Blended Teaching Mode of Mechanical Principles Course Scaffolding in the Context of New Engineering Science

Dongya Li[a], Guoping Feng, Wangchao Jiang, Henan Qi

Applied Technology College of Soochow University, Suzhou 215000, China

[a]E-mail: lidongya@suda.edu.cn

Abstract

Based on the background of the construction of new engineering disciplines, there is a disconnect between theory and practice in the traditional teaching mode of mechanical principle course, which is difficult to achieve the purpose of training students. Therefore, this paper proposes a"project design"as the leading scaffolding blended teaching mode, including "scaffolding - entering the case situation - independent exploration - collaborative learning The closed-loop teaching chain of "learning effect evaluation" integrates the knowledge system, practical ability and ideological value. The knowledge is divided into three levels of scaffolding according to the degree of difficulty of the project, online and offline combinations are used to determine the project using real cases in the industry as the carrier, interdisciplinary teams and university-enterprise dual-mentor collaborative design are used to determine the relevant tasks of the project, and three-dimensional competence evaluation criteria are used to evaluate the completed project. Therefore, this paper is of some significance for the teaching of engineering foundation courses in new engineering disciplines.

Keywords

Project design; Scaffolding; Case scenarios; Dual mentorship.

1. Introduction

In the face of the new round of scientific and technological revolution and industrial change, the construction of new engineering disciplines, as an important breakthrough in the field of higher engineering education [1], puts forward the demand for the cultivation of innovation ability, practical ability and cross-boundary comprehensive ability of mechanical specialists [2], and the disadvantages of traditional teaching modes, such as"heavy theoretical teaching, light practical innovation", "heavy knowledge The disadvantages of traditional teaching modes such as "theory teaching, light on practical innovation", "knowledge inculcation,light on the cultivation of thinking"and so on are becoming more and more prominent, and they cannot adapt to the requirements of the talent cultivation goal of "discipline crossover, industry-teaching integration and innovation-driven"in the context of the construction of new engineering disciplines [3-4]. How to use teaching mode innovation to solve the problems of disconnection between theory and practice, separation of online and offline resources, and imbalance between knowledge transfer and ability cultivation in course teaching is the focus of the current research on education and teaching reform.

Scaffolding teaching, to build a dynamic knowledge scaffolding based on students' ability, led by the teacher, students learn independently to form a knowledge system, blended teaching will use Internet technology combined with offline teaching activities [5], the integration of the two makes the advantages of the two complement each other, giving full play to the various advantages. In this paper, under the talent cultivation requirements of the new engineering discipline, for the problems existing in the teaching process of the mechanical principle course,

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it is proposed to adopt the scaffolding blended teaching mode, and the method and realization of the mode construction are clarified, based on which, the engineering thinking of the students will be enhanced, and the cultivation of the students' mechanical design ability and innovation ability will be strengthened, in order to provide a feasible teaching reform for the engineering foundation course under the background of China's new engineering discipline ideas and methods.

2. Problem Analysis

“Principles of Mechanics”course is facing many problems in the context of the construction of new engineering disciplines, and the problem of disconnection between the traditional teaching mode and the cultivation of innovative talents is becoming more and more serious, and the teaching objectives are still overly focused on the teaching of theoretical knowledge (mechanism, motion and dynamics), and not enough attention has been paid to teaching objectives such as “complex engineering problem solving ability”and”interdisciplinary thinking”,which are emphasized in the new engineering disciplines. The teaching objectives are still overly focused on theoretical knowledge (mechanism, motion and dynamics), and not enough attention is paid to the teaching objectives of “complex engineering problem solving ability” and “interdisciplinary thinking”, which makes it difficult for students to transform the knowledge of mechanism design and motion analysis into the ability of engineering practice.

Teaching content: the teaching material system lags behind the industrial development, mainly around the classical mechanism (crank-slider mechanism, gear transmission, etc.) to develop, for intelligent equipment in the flexible mechanism, bionic machinery, ultra-precision robotics and other emerging areas of the narrative is less, and there is no robotics, intelligent manufacturing and other cutting-edge industries throughout the knowledge, resulting in the course of the island of knowledge The phenomenon of “course knowledge island”. Teaching methods: the use of “blackboard + PPT” one-way teaching is the main reason; most of the experimental links to verify the experiments (such as gear Fan Cheng experiments), the lack of new engineering advocated the application of project-based, case-based teaching; in the innovative design of the mechanism, motion simulation analysis and other aspects of the practical process of the student's degree of participation and self-motivated less. self-motivated less.

The current teaching evaluation system tends to “emphasize the results, light process” [6], too much emphasis on the theoretical assessment results, ignoring the creative design of the program, teamwork and innovative design and other process factors on the measurement of the actual ability of the students, and can not accurately reflect the core qualities of the talents of the new engineering disciplines. This kind of problem makes the course teaching and new engineering “innovative, practical, comprehensive” far away, and there is an urgent need to seek a breakthrough and innovation from the teaching mode.

3. Mechanical Principle Scaffolding Mixed Teaching Mode Establishment

This part of the “project design” as a carrier to build a scaffolding blended teaching mode, the construction of “scaffolding - into the case situation - independent Exploration - collaborative learning - learning effect evaluation” closed teaching chain, to realize the integration of mechanical knowledge, engineering practice and ideological value.

3.1. Erection of scaffolding

According to the degree of difficulty of the project, the knowledge layer of Mechanical Principles is divided into three layers: “basic cognitive layer”(e.g. mechanism kinematics, calculation of degrees of freedom),“application technology layer”(linkage mechanism, cam mechanism, gear

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mechanism, wheel system), and "innovation design layer"(mechanism configuration innovation, engineering optimization); respectively corresponding to the preparatory activities, generative activities and concluding reflections in the teaching of the course. Innovation design layer"(mechanism configuration innovation, engineering optimization) three levels, corresponding to the preparatory activities, generative activities and summary reflection in the course teaching; and in the super star platform to establish a complete online course: including 60 multimedia guest courseware, 60 video resources and a total of 630 questions in the test bank; in addition to provide students with other online courses, including the love of the course network, catechism network, etc. In addition, students were provided with other online resources, including Love Course and Mucon.

3.2. Entering the case scenario

Select industrial projects according to industrial needs, and choose real engineering projects or products in the fields of intelligent manufacturing and robotics technology as project carriers, such as the project of "joint mechanism design of rehabilitation robot", which is divided into sub-tasks such as "structural analysis - mechanism design - program design". For example, in the project "Rehabilitation Robot Joint Mechanism Design", the project is divided into sub-tasks such as "Structure Analysis - Mechanism Design - Program Design", and the case packages (including industry standards, such as ISO Robotics Performance Specification, enterprise design process, etc.) are released online to guide the students to recognize the significance of the mechanism design from the engineering perspective of "solving the needs of clinical rehabilitation", and at the same time, penetrate into the ideological concept of "Science and Technology Serving People's Livelihood". At the same time, the students were infiltrated with the ideology of "science and technology serving people's livelihood".

3.3. Independent exploration

Online platform to assist offline practice, students through the online SolidWorks, UG and other platforms to complete the institutional trajectory simulation experiments [7], and then go to the offline laboratory to build the institutional model, adjusting the relevant parameters, for example, in the "gear mechanism design" link, the students first use the online gear model into a virtual experiment to verify the theoretical tooth shape, and then use the offline gear processing training equipment to produce actual parts, and finally through the "trial and error - correction" process to exercise engineering thinking. For example, in the "gear mechanism design" link, students first use the online gear modeling virtual experiment to verify the theoretical tooth shape, and then use the offline gear processing training equipment to make actual parts, and finally exercise engineering thinking through the process of "trial and error - correction".

3.4. Collaborative Learning

Interdisciplinary team and school-enterprise dual tutoring system to form an interdisciplinary team including mechanical, electromechanical, control, and other majors to carry out collaborative design around complex projects (such as "intelligent logistics sorting robot mechanism design"). The company engineers are introduced as external mentors to work with the on-campus teachers to guide the program review.

3.5. Evaluation of learning outcomes

To build a competence assessment system with the dimensions of "knowledge mastery, practical innovation and value recognition", the assessment system consists of process assessment, final examination and incentive mechanism, of which the process assessment accounts for 60% of the total assessment scores (including attendance, homework and project quality); the final examination accounts for 40% of the total assessment scores; The incentive

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mechanism, on the other hand, refers to the measures for students to get extra points for the corresponding achievement levels obtained within the scope of the course.

4. Civic and Political Elements Into The Curriculum

The richness is manifested in the inclusion of a large number of professional knowledge and engineering practice activities connotation and the value of Civic and political education, in the teaching of professional knowledge and practical teaching, the Civic and political education elements throughout [8]. Introducing the history of the development of machinery, reflecting the infinite wisdom of the ancient craftsmen of China and a series of major breakthroughs in the field of science and technology; interpreting the reliability design of the mechanical system, conveying the spirit of the scientists who are not afraid of difficulties and obstacles and overcoming obstacles; guiding the students to cooperate in groups to carry out engineering practice activities, cultivating the character of students who are bold in taking responsibility and innovation, and completing the Civic and Political Education in the process of explaining the above knowledge. So that students not only learn to master the knowledge and application of mechanical principles, but also have a correct outlook on life in the process, focusing on cultivating the overall development of students, aiming to cultivate students not only to meet the professional requirements, but also to be able to take into account the needs of the country and the nation's high-quality engineers.

5. Summary

This paper focuses on the teaching pain points of the mechanical principle course in the context of new engineering disciplines, and constructs a mixed teaching mode with “project design” as the core. The model is designed through the closed-loop five-level teaching link, which integrates online knowledge scaffolding and offline practice scenarios in depth, forming a hierarchical teaching system of “basic cognition-application technology-innovation design”, and at the same time, embedding the real cases of the industry and interdisciplinary collaboration mechanism, which realizes the transformation from the teaching of knowledge to the cultivation of engineering ability. This model effectively solves the problems of disconnecting theory and practice and single evaluation system in traditional teaching, and significantly improves the students' ability in institutional innovation design and teamwork, etc. The integration of the ideological and political elements of the course also makes the values of “serving the country with science and technology” and “unity and cooperation” permeate the whole teaching process. The integration of the ideological and political elements of the course also makes the values of “serving the country with science and technology” and “unity and cooperation” permeate the whole teaching process. In the future, we can further expand the in-depth cooperation with intelligent manufacturing enterprises, optimize the degree of intelligence of the online virtual simulation platform, and continue to improve the three-dimensional cultivation system of “Knowledge-Capability-Value”, so as to provide a more universal practical paradigm for the innovative teaching of basic engineering courses in the context of new engineering disciplines.

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