The Teaching Reform of College Physics under the Guidance of New Engineering Talent Training

Xiuying Gao[a,*], Wenjuan Wu[b], Li LUO[c], Hui SUN[d]

College of Optoelectronic Engineering, Chengdu University of Information Technology, Chengdu, Sichuan 610103, China

[a] gaoxiuying@126.com, [b] wwj@cuit.edu.cn, [c] rolly80218@163.com, [d] sunhui@cuit.edu.cn

**corresponding author*

Keywords: New engineering talent training, College physics, Teaching reform

Abstract: New engineering talents training provides new ideas for the college physics teaching reform, and introduces new teaching ideas, new quality pursuit and new teaching mode for college physics teaching. Chengdu University of Information Technology has carried out a comprehensive teaching reform of college physics with the teaching concept of “paying equal attention to knowledge and ability” and the goal of improving the high order of the course, highlighting the innovation of teaching and increasing the challenge of knowledge.

1. Introduction

In 2017, the Ministry of education sounded the clarion call for the construction of new engineering and actively promoted new engineering construction. Three fundamental changes have occurred in the training of new engineering talents due to the new technology, economy and business forms [1]. New engineering talents should have solid professional knowledge and skills, comprehensive qualities such as family and country feelings, critical and systematic thinking, and non- professional abilities such as innovation ability and team cooperation ability [2]. As a basic and core compulsory course for science and engineering majors, college physics plays an irreplaceable role in cultivating new engineering talents.

At present, there are five common problems in the college physics curriculum. First, the curriculum objectives do not match the new engineering talent training. Second, knowledge structure is out of date, knowledge and application are out of step, teaching content lacks advanced and epochal nature. Third, the teaching method is still based on classroom teaching, and the integration of teaching means and informatization is insufficient. Fourth, the assessment method is single, which can’t investigate students' scientific literacy and innovation ability. Fifth, the evaluation system is not perfect and can’t effectively promote the deepening of teaching reform. Therefore, college physics must closely follow the strategy of new engineering talent training and carry out teaching reform in time to meet the new requirements of the construction and development of new engineering. In recent years, guided by the training goal of new engineering talents, Chengdu University of Information Technology (CUIT) has carried out in-depth teaching

  DOI: 10.25236/isaete.2021.046

reform on the teaching goals, teaching contents, teaching methods, assessment mode and evaluation system of college physics.

2. Teaching Reform of College Physics

2.1 Reshaping Curriculum Goals

As the core basic compulsory course of science and engineering majors in CUIT, college physics undertakes the important task of imparting physical knowledge, cultivating and utilizing physical thinking and enhancing patriotism. The course organically integrates “knowledge learning, ability training and scientific literacy training”, which takes establishing morality and cultivating people as the ideological and political goal of the course, also takes both morality and ability as the professional goal of the course. As shown in Figure 1, the curriculum goal is the training requirements of professionals, and the one-level indicators is the teaching objective, emphasizing the cultivation of knowledge, ability and quality. The two- and three-level indicators are the subdivision of teaching goals, which is convenient for the implementation and realization in the process of teaching practice and the quantitative assessment of teaching quality.

Curriculum goals	One-level indicators	second-level indicators	Third-level indicators
(1) Master the basic knowledge of physics and the ideas and methods of physics research.	1 physics basic theory	1.1 Basic knowledge of Physics	1.1.1 Basic knowledge
			1.1.2 Application of knowledge
(2) Ability to build physical models, ability of qualitative analysis and quantitative calculation, self study, practice and problem-analyzing and solving abilities.	2 Personal ability	2.1 Logical reasoning and problem solving ability	2.1.1 Discover and express physical problems
			2.1.2 Discover the law and establish the physical model
			2.1.3 Qualitative analysis and quantitative calculation
		2.2 Engineering application ability	2.2.1 Conception and method of engineering application
(3) Cultivate the spirit of scientists, the spirit of innovation and exploration, humanistic quality and family and country feelings.	3 Professional ability and quality	3.1 Self study ability and innovation ability	3.1.1 Innovative consciousness
			3.1.2 Active learning and development ability
			3.1.3 Desire for knowledge and lifelong learning
		3.2 Scientific literacy, family and country feelings	3.2.1 Correct scientific view
			3.2.2 Scientific spirit of seeking truth from facts
			3.2.3 National pride

Fig.1 Curriculum Goals

2.2 Restructuring Course Content

The implementation of curriculum goals depends on the teaching content. The teaching content should reflect the breadth and depth, break through the habitual cognitive mode, and cultivate students' spirit and ability of in-depth analysis, bold questioning and innovation. The course adds innovative, challenging, expansiveness, advanced and research contents, scientifically increases the student learning input, and burden, which enables students to experience the learning challenge that “jump” is enough to achieve. The content construction is shown in Figure 2.

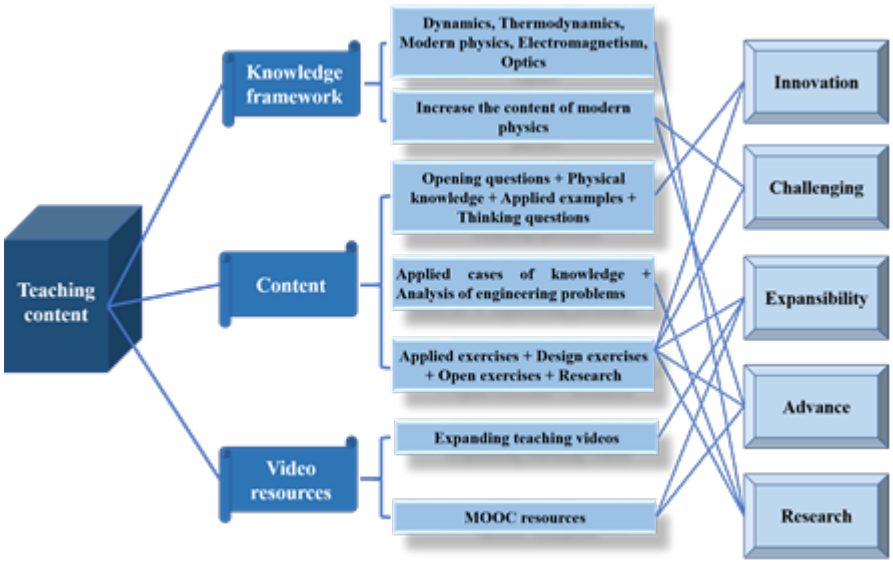

Fig.2 Teaching Content Design

(1) Increase the content and class hours of modern physics. Combined with the cutting-edge science and technology, the course pays attention to the frontier of knowledge and the cross integration of disciplines, so as to effectively stimulate students' innovative consciousness and struggle spirit.

(2) The course content adopts the mode of “question import + teaching of physical knowledge + engineering application examples + thinking questions”, as shown in Figure 3. This mode is convenient for teachers to adopt heuristic teaching methods, which can cultivate students' ability to find and analyze problems, strict logical thinking ability, using knowledge to solve practical problems, and engineering thinking and engineering application ability.

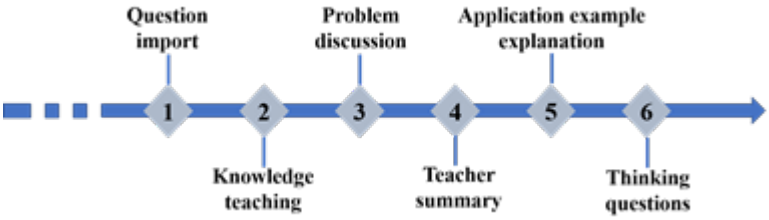

Fig.3 Classroom Content Model

(3) The course sets up typical application cases to show the practicability of physics knowledge and let students perceive fresh physics.

(4) The newly added open exercises, which takes the theoretical innovation, new technology invention and practical application in the development of physics as materials, guide students to master physical ideas and physical methods, and cultivate students' scientific spirit, innovative spirit and family and country feelings. The extracurricular design needs team members work together to use the learned physics knowledge for device design, which can cultivate students' teamwork ability, innovation ability and the ability of integrating theory with practice. The research exercises enable students to conduct scientific research under the guidance of teachers, and cultivate students' scientific spirit of seeking truth from facts, daring to explore and daring to innovate.

(5) The course adds science video related to physics knowledge to help students understand physics knowledge, expand the horizons, and let students contact the latest science and technology to improve the interest in learning.

2.3 Innovating Teaching Methods

The course adopts diversified teaching methods to deepen students' understanding to knowledge, guides students to find new problems and innovate. The course focus on the knowledge expansion, supplemented by classroom teaching, and constantly explore new teaching modes. Combined with MOOC resources, a flipped classroom can be introduced to stimulate students' learning initiative and innovation desire [3]. The teachers carry out extracurricular research to cultivate students' ability to analyze and solve problems, innovation consciousness and innovation ability, team cooperation ability and innovation consciousness. The classroom discussion can guide students to find problems, use knowledge to solve problems, summary ability. With the MOOC, SPOC and other teaching platforms, the teachers use online and offline mixed teaching, to break the restrictions of time and space on learning, and to cultivate students' self-study ability.

2.4 Reforming Assessment Mode

The achievement of curriculum goals depends on the perfect assessment mode. With output oriented, the course adopts the whole process assessment mode [4], pays equal attention to knowledge and ability, and enhances students' sense of achievement in acquiring knowledge through hard study. The question type and content of the final exam takes into account both knowledge and ability. All links of the process assessment are clarified, which helps to urge students to “jump”, as shown in Figure 4.

Fig.4 Assessment Mode

2.5 Improving Evaluation System

Whether the curriculum goals are reasonable, the implementation of curriculum goals and the achievement of curriculum goals need to be evaluated through a reasonable evaluation system. According to the teaching method and assessment mode, the combination of quantitative and qualitative evaluation, subjective and objective evaluation, self and external evaluation are adopted to understand the teaching achievement and existing problems more comprehensively and objectively, as shown in Figure 5.

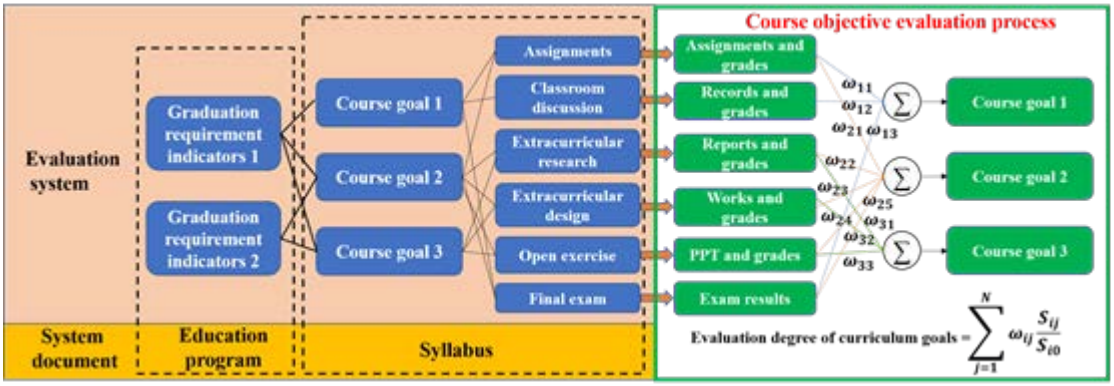

Fig.5 Achievement Evaluation Design

3. Conclusion

According to the goals of new engineering talents training, in view of these problems in the college physics teaching, CUIT has carried out teaching reform and practice of college physics, including teaching goals, teaching contents, teaching methods, assessment mode and evaluation system, which has promoted the organic integration of “knowledge learning, ability training and scientific literacy training”.

Acknowledgement

Authors gratefully acknowledge the support of Sichuan Province Higher Education Talent Cultivation Quality and Teaching Reform Project 2018-2020 (No. JG2018-527).

References

[1] Jiang G., Guo J., Liu B., et al. Current Status and Innovation Measure of College Physics Teaching under the Background of “New Engineering”. Journal of Shangrao Normal University, vol.40, no.6, pp.20–23, 2020.

[2] Yang M.. Reform and Practice of Physics Teaching Mode in Colleges and Universities Based on the Cultivation of Innovative Ability. Journal of International Education and Development, vol.4, no.5, pp.148-152, 2020.

[3] Li S., Li Y. and Liu X.. Research on college physics teaching under the background of “Internet + “. Heilongjiang Science, vol.10, no.9, pp.40-41, 2019.

[4] Zhao W. H.. Exploration and Practice of Whole Process Assessment Mode Focusing on Learning Process. Journal of Higher Education, vol.19, pp.86-89, 2019.