

Research and Development of the Application-Oriented Major Basic Chemistry Curriculum in the Context of New Engineering

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Abstract

Review Article

Training of applied talents under the background of new engineering adapts to the requirements of scientific and technological revolution and industrial revolution under the new situation. The application-oriented major should start with the concept of OBE education and based on the results-oriented teaching mode to cultivate a group of technical innovation, technological innovation and thinking innovation of the new era of applied talents. The education and teaching reform of basic chemistry course under the background of new engineering will promote the development of the training and construction of applied talents. This paper reviews the research and development of foreign universities under the background of new engineering, and prospects the construction of basic chemistry courses for applied undergraduate majors under the background of new engineering.

Keywords: The new engineering; the application-oriented major; basic chemistry; research and development.

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1. RESEARCH BACKGROUND

Under the new situation, it is necessary to carry out scientific and technological revolution and industrial revolution to advocate the cultivation and training of diversified and innovative engineering and scientific talents, and finally achieve "Fudan consensus"[1], "Tianjin University Action"[2] and "Beijing Guide"[3]. Colleges and universities are important bases for talent cultivation, so it is particularly important to deal with the revolution actively. The orientation of application-oriented undergraduate universities is to cultivate a group of applied technical talents, that is, to cultivate students based on the teaching model of results-oriented OBE education concept. In the course of education and teaching, the training of students' practical ability and innovative ability will be paid more attention, and the construction of basic chemistry course will play a strategic significance to promote and innovate the development of applied talents training under the background of new engineering in China [4-6].

2. Research and Development of Foreign Universities under the Background of New Engineering

American colleges and universities promote design-based learning by engaging students in open-

ended projects that develop modeling and simulation skills as well as teamwork and communication skills. At northwestern university, for example, three kinds of design project for students, teachers create project, students created project, customers create project), through two stages teaching, taught by engineering college teachers in the form of group design ethics, project management, communication and team cooperation key content, such as by a mentor or coach to guide the project is completed the design of concrete work [7, 8]. In the first year of engineering at Stanford University, freshmen are taught mechatronics, a substantive project, to learn about mechanics, circuits and other components in theory and practice. Students from different departments can experiment, brainstorm, and come up with creative designs in engineering schools instead of working behind closed doors. In terms of major selection, students can even design their own interdisciplinary majors; Close to the global entrepreneurship base (Silicon Valley), students are always in the entrepreneurial atmosphere, and can independently complete a series of project research work such as project application, fund raising, plan formulation and organizational structure [9, 10]. According to the development path of Harvard Engineering School, the construction of new engineering should be oriented to serve the national strategy and meet the future needs, and promote the

deep interdisciplinary integration of disciplines. To integrate into the regional development, optimize the spatial layout as the starting point, promote the integrated development of industry, education and research [11, 12]. College of Engineering, Purdue University education reform practice, believes that the construction of new engineering should build a multidisciplinary interdisciplinary talent training system, play the role of students to promote, all-round and multi-angle training and enhance the core competence of students [13, 14].

Canada focuses on the practicality of project engineering. The University of Ottawa and the University of Waterloo have practiced cooperative education (Co-OP) talent training mode for many years — The University of Ottawa has been Co-OP for 35 years [15, 16] and the University of Waterloo began Co-OP in 1957 [16]. This model combines both study and work. Students have at least 6 internships for a total of 20 months. The practical experience of the past two years is also highly valued by employers. McMaster University adopts the model of Problem-based learning (PBL), which emphasizes on students' active learning and designs real projects. Students can solve problems in complex and realistic problem situations by self-inquiry and group cooperation, thus forming practical skills and abilities [17].

Singapore University of Technology and Design advocates a grand design view of engineering education model, which starts with design in one course, then cross-disciplinary and cross-professional design between courses, and then across different majors and grades, and finally, the full simulation of extracurricular practice. Students learn basic courses in the first and second years, choose core courses in four fields independently in the third year, and develop students' abilities in economics, humanities, arts, social sciences, entrepreneurship and management in the fourth year to complete the graduation project [18].

3. Research and Development of Domestic Universities under the Background of New Engineering

“Beijing Guide” has sounded the assembly of new engineering construction, the Ministry of Education calls on us to change from “runner” to “leader”, the construction and development of new engineering is imperative. Facing the international and domestic situation, engineering education reform is imperative in order to break through the core and key technologies, build the first-mover advantage, and occupy the strategic commanding position in the future global innovation ecosystem. All kinds of colleges and universities should be carried out in different levels, different fields new engineering construction, guided by the demands of industry, to locate the corresponding engineering excellence talents cultivating goal, build the “wisdom of transboundary impact, an innovative

thinking, fusion and win-win” education of new ideas and “results oriented advanced undergraduate course education” new cultivating mode, improving the quality of engineering education, boost the economic transformation and upgrading, So as to meet the international competition and challenges of new technologies and new industries in the future [19, 20].

Under the background of new engineering, the construction of courses of various majors mainly focuses on basic public courses. For example, Qiang Wang [21] of Shaanxi Normal University has explored the teaching of organic chemistry course of new energy device major, and made exploration and adjustment in the selection and content of textbooks, teaching methods, assessment methods and experimental teaching contents. Dr. Lei Ma [22], who works in environmental engineering major of Beijing Institute of Petrochemical Technology, took the organic chemistry course teaching as an example, analyzed the existing problems in the course teaching process, and put forward new teaching ideas and methods. On this basis, the educational concept of “student-centered” was introduced and integrated into the basic chemistry course construction of environmental engineering major. Reform the existing teaching model of the course, redesign the course as a whole, so as to stimulate students' interest and improve students' learning effect. Dr. Biqiong Hong [23], who works in College of Oceanology of Minjiang University, explored the teaching method and way to adapt to the development concept of the new era. In this paper, combined with the teaching practice and reflection of the applied local school, the teaching content of organic chemistry was rationalized, the experimental process was green, and the examination method was optimized. Wenlu Zhao [24], who works in the School of Environmental Science and Engineering of Zhejiang Gongshang University, combined theoretical knowledge of organic chemistry with professional knowledge of environmental discipline, which became a big challenge in teaching the course. Using LBL-TBL integrated teaching method, she selected appropriate teaching materials and focused on cutting teaching content. And she optimizes the teaching content by combining with professional knowledge. At the same time, she diversified teaching methods can achieve good teaching effects. Thus, it is beneficial to improve students' learning initiative, analysis and problem solving, good at thinking and innovation ability, and lay a good foundation for the future study of professional courses. The new engineering education has become an important driving force of higher education in China. As an important part of the basic chemical knowledge system, organic chemistry plays an important role in the course teaching. Combined with many teachers in colleges and universities such as Dr. Yong Wang [25] and Dr. Wenqian Zhang [26] study of the problems in the process of organic chemistry teaching, the teaching tools, teaching content, teaching means, learning way of

analysis, evaluation and etc are discussed in this paper, with the students' autonomous learning ability, innovation ability and scientific research ability, effectively raise the quality of the cultivation of applied talents.

Under the background of new engineering construction, "Golden Course" has become one of the most important keywords in China's higher education reform in the new era. According to the research on the construction of "Gold Course" of "organic chemistry" of Dr. Xu Ren [27] from Chengdu University majoring in Environmental engineering, Professor Jinbing Liu [28] of Shaoyang College, and Associate professor Jiehu Cui [29] of Zhengzhou Aeronautical Industry Management Institute: The teaching should aim at cultivating high quality compound talents of environmental engineering major under the background of new engineering. By combining traditional teaching mode with "flipped classroom", case learning, simulation experiment teaching and other means, the existing teaching mode of the course should be reformed, so as to stimulate students' interest and exercise students' practical innovation ability. The course should be student-centered, the teaching content should be optimized, the teaching method should be reformed and the teaching effect should be improved. According to the "two nature and one degree" "Gold Course" standard advocated by the Ministry of Education, this paper explores a new teaching model of basic chemistry from the aspects of teaching content design, teaching method reform, teaching problems reflection, continuous improvement of teaching methods and evaluation methods of course results, and strives to promote the improvement of students' learning ability, comprehensive ability and learning effect.

Hongjie Zhang [30], from the School of Resources and Environmental Engineering of Wuhan University of Science and Technology, reformed the curriculum to meet the needs of the development of science and technology industry for the development of high-quality safety engineering professionals. Based on the concept of CDIO international engineering education and innovative education practice, taking the course of building fire safety engineering as an example, this paper makes relevant research and exploration from the aspects of teaching material construction, teaching method improvement and optimization, practical teaching innovation and examination method reform, etc., by giving full play to the discipline advantages and integrating scientific research resources. Penghui Gao [31], a professor from the School of Mechanics and Civil Engineering, China University of Mining and Technology, believes that for undergraduate education of built environment and energy application engineering, improving the training system and mechanism has become an important

starting point for cultivating forward-looking composite talents.

4. Prospect of the Construction of Basic Chemistry Courses for Applied Undergraduate Majors under the Background of New Engineering

Basic chemistry course is an important basic compulsory course offered by local ordinary colleges and universities, especially for applied undergraduates. It is composed of general chemistry, organic chemistry, analytical chemistry and basic chemistry experiment of universities. The courses are set in the first semester or the second semester respectively, and the credit hours range is 32 ~ 84. The construction of basic chemistry course will be carried out from the four aspects of revising the syllabus; teaching content, teaching methods and assessment methods, and give full play to the practice and innovation of experimental course. At the same time, based on the national development trend, social demand for application talents and the direction of the students in this major, we will continue to explore and improve, which will enable students in application-oriented universities to put what they have learned into practice and serve their postgraduate entrance examination, employment and ability cultivation.

The related experiment of basic chemistry course is also an important basic experiment of chemistry and related subjects in colleges and universities, and also plays a very important role in many practical courses. It not only cooperates with the basic chemistry theory teaching, so that students can carry on the deeper understanding of the knowledge through the experiment; at the same time, it has its own independence and system. For example, in the teaching of "Organic Chemistry Experiment", the reform and practice of experimental teaching content and teaching methods will greatly stimulate students' interest in learning, so that students' comprehensive quality and scientific research and innovation ability can be developed, so that the goal of training innovative talents in new engineering can be realized.

According to the concept of professional certification and the new requirements of new engineering for talent training, the problems existing in the existing talent training program are analyzed. At the same time, it also put forward a new idea of the adjustment scheme of the new engineering major course structure system, which is student-centered, professional certification and achievement oriented, and builds the "platform + module" course system structure.

Fund Project

1. Research Project on Teaching Reform of Higher Education in Heilongjiang Province (Construction and practice of basic chemistry courses for applied undergraduate majors under the background of new engineering; Serial number: SJGY20210625).

2. Project of Education Department of Heilongjiang Province (Research and practice of organic chemistry “Gold Course” construction based on the combination of online and offline mixed teaching mode; Serial number: SJGY20190472).
3. Education and Teaching Reform Research Project of Heilongjiang Bayi Agricultural University (Exploration and practice of organic analysis teaching reform in applied chemistry under the background of new engineering).
4. “Curriculum Ideological and Political” teaching reform project of Heilongjiang Bayi Agricultural University, Course name: Organic Analysis.

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