Modern Management Based on Big Data IV
A.J. Tallón-Ballesteros (Ed.)

doi:10.3233/FAIA230214

Exploring the National First-Class Specialty Construction of Pharmaceutical Engineering Under the Background of "New Engineering" Project

Zhenhua CHEN[a], Zekai CHEN[a], Liangliang ZHOU[a], Pengwu ZHENG[a], Yuyu XU[1,b]
[a] *School of Pharmacy, Jiangxi Science and Technology Normal University, Nanchang 330013, China*
[b] *College of Tourism and History Culture, Jiangxi Science and Technology Normal University, Nanchang 330022, China*

Abstract. The present study envisages the construction and reforming practice of the national first-class specialty in local colleges under the background of the "New Engineering" project. Specifically, the construction of engineering teaching team, and the construction of practical teaching platform within and out of universities have been explored. Furthermore, the revolution of the teaching method and medium and the cultivation of innovative talents has been discussed. With the implementation of the "New Engineering" reform and other professional construction initiatives, the quality of pharmaceutical engineering education in the School of Pharmacy, Jiangxi Science and Technology Normal University has significantly improved, and the influence and reputation of the specialties has been significantly enhanced. As a result, the Pharmaceutical Engineering major of the Jiangxi Science and Technology Normal University has been rated as a first-class advantage specialty in Jiangxi Province in 2022, and has ranked first in the comprehensive evaluation of majors in Jiangxi Province for two consecutive rounds.

Keywords. New engineering; Pharmaceutical engineering; First-class specialty

1. Introduction

In the present global scenario, a new round of scientific and technical revolution accompanied with the industrial transformation has accelerated, thereby leading to an intensified competition in the comprehensive national strength among different countries. To accelerate the construction of the new engineering specialty, and facilitate the economic transformation and upgradation, there is an implementation of a series of ongoing significant strategies such as "Innovation-driven Development", "One Belt, One Road", "Internet Plus", and "Made in China 2025". To pave a way in the vigorous development of the new economy characterized by new technology, there is a need of innovative forms of business and industries. In this pursuit, there is an inevitable need

[1] Corresponding Author: Yuyu Xu, College of Tourism and History Culture, Jiangxi Science and Technology Normal University, Nanchang 330022, China; E-mail: 55762031@qq.com.

of engineering talents with a higher ability of innovation, entrepreneurship and cross-border integration.

In order to satisfy the strategic demand of new engineering talents in the new economy and new industries, the Ministry of Education of China has put forward the "New Engineering" action plan of higher education of engineering in February 2017. This plan aims to cope with changes and shaping the future using an approach of inheritance and innovation, cross and fusion, and coordination and sharing. This can cultivate diversified and innovative outstanding engineering talents for providing intellectual security and talent support in the development of the new economy and new industry [1].

According to the basic characteristics of the new industry and the basic requirements of the new engineering, the main shortcomings of the existing talent cultivation system in most local engineering colleges are the insufficient openness and integration towards industries, and the weakness of adaptability and support. These can be specifically described as: (1) The developments in the positioning and connotation of universities are not compatible with the national economic development strategies and industrial development needs; (2) The talent cultivation system does not adapt to the industrial development; (3) The school-enterprise interaction system cannot meet the needs of the talent cultivation and collaborative innovation in the context of the new industry; (4) Implementation of discipline and scientific research activities do not satisfy the industrial demands and feedback to talent cultivation; (5) The training system cannot effectively support the achievement of the goal of the new engineering talent cultivation; (6) The university governance system cannot meet the needs during the construction of the new engineering system.

Considering the local undergraduate institutions of the education level, and its positioning of training applied talents for the local area, the present study thoroughly leveraged the advantages of the numerous high-quality practical base and rich experience in school-enterprise cooperation, under the basis of the preliminary pharmaceutical category cultivation [2]. This can be achieved by a proper combination of the actual situation of the major and with the guidance of the demand of modern pharmaceutical companies [3]. Further, by employing the innovative talent training modes, such as the integration of production-engineering education, cooperation between the school-enterprise, promoting the reform of curriculum system and teaching evaluation, and exploring the construction and reform of the national first-class specialty in local colleges, the aforesaid goals can be realized [4-6].

2. Construction of the Teaching Group

A teaching team with a strong practical experience of engineering is a significant condition for ensuring the requirements of the "New Engineering" implementation. Although our teaching group has a combination of the subject expertise and strong engineering practical abilities, the School of Pharmacy has employed various measures to build an engineering teaching team that comprehends the development of the pharmaceutical industry and satisfies the needs of engineering talent cultivation, in order to successfully implement the "New Engineering" project and to construct the national first-class specialty. The specific measures are shown in the Figure 1.

Figure 1. Measures adopted by the engineering teaching team.

3. Construction of the Engineering Training Center

3.1. Construction of Engineering Training Center conforming to GMP standards

In order to enable the students to see and use the common manufacturing facility of the pharmaceutical companies and familiarize its working principle, our institute has built a GMP-compliant oral solid preparation engineering training center, equipped with advanced equipment containing automatic control system and air purification system. This training center is able to simulate the actual production scenarios of the pharmaceutical companies, so that students can master the core engineering literacy and practical aspects of pharmaceutical engineering. Furthermore, this training not only fulfills the internship and practical training needs of students, but also undertakes the extracurricular scientific and technological innovation activities and various scientific and technological competitions.

3.2. Construction of Virtual Simulation Training Center

Construction of virtual simulation training center is an essential development in the virtual simulation teaching, which enables the students to grasp a better understanding of the real production environment, process, and principles in real pharmaceutical industries, through a highly immersive teaching mode. With the support of the Ministry of Education's collaborative practice project for industry-education integration, our institute has constructed a virtual simulation training center that covers the virtual experiments on solid oral dosage forms, injections, chemical drugs, and traditional Chinese medicine production, through independent research and cooperation with enterprises. Together with the engineering training center and experimental teaching center, it has formed a combined virtual and real on-campus practical teaching platform for pharmaceutical engineering.

4. Construction of Practice Teaching System outside school

4.1. Establishing the Assurance management agency employing the "government-school-industry-enterprise" cooperation

The institutes should establish a structurally sound, clearly managed and assigned authorized representative cooperative organization with the government departments and industry enterprises. This can be an important factor in ensuring the implementation and development of the bidirectional integration of production, and can guarantee the establishment of stable off-campus internship bases. In 2009, the School of Pharmacy, Jiangxi Science and Technology Normal University established a professional teaching guidance committee with experts from the industry and enterprise as the main members. For achieving a better work-performance, experts from pharmaceutical companies in other provinces were invited to participate in the committee and revise the committee charter to clarify the responsibilities and rights of the committee. The committee was responsible for studying the requirements and trends of industry and professional development, and determining the objectives of the talent training. Other objectives of the committee included, determining the knowledge and ability structure of graduates, coordinating the management of on-campus and off-campus internships and job training, and carrying out scientific research and training, and recommending graduates.

4.2. Establishing the Evaluation Standards for Off-Campus Internship

It is essential to regularly launch the evaluation and dynamic adjustment of off-campus internship bases to ensure the quality of internships. Feedback should be provided to the internship bases that fail to meet the evaluation standards, and their qualifications may be canceled if a serious problem appears. The evaluation process should be standardized that has practical and feasible evaluation standards, generally including the following contents: (1) Essential facilities: The internship base should be equipped with the teaching, experimental, internship, and scientific research facilities and other hardware conditions necessary for the student internships. (2) Organized Team: The internship base should lay strict rules and regulations to ensure that students' learning in the internship base is productive. (3) Appropriate Guidance: The internship management and guidance personnel receiving a higher education have a certain amount of theoretical and professional knowledge, and have a rich practical experience and professional skills. Such personnel should be arranged by the internship base to charge and guide the students to study. (4) Undertaking Assessments: The internship base should summarize the internship situation of the interns and evaluate their comprehensive performance during the internship, which provides a basis for the school to evaluate the students' internship performance.

4.3. Establishing a Collaborative Education Model with the Combination of "Industry-University-Research"

By establishing the school-enterprise cooperative internship bases, enterprises provide internship conditions to the schools and create a good internship environment for students. Furthermore, the colleges actively combine the "Industry-University-

Research" cultivation model and cooperate with the off-campus internship bases in accordance with the principle of complementary advantages and mutual benefit. This transforms the scientific and technological research and the talent advantages into productivity, thereby improving the overall competitiveness of the enterprises. Meanwhile, the practice and financial advantages of the off-campus practice base should be utilized to transform it into a test base for product development and scientific research promotion of colleges and universities. The school-enterprise cooperation training can sustainably develop only through the complimentary interaction between the schools and enterprises.

5. Methods and Measures of Improving Teaching

The implementation of the "New Engineering" reform is a very systematic project, in which the reform of the teaching methods and means is a vital factor. The measures to carry out the reforms by the project team are summarized in Figure 2.

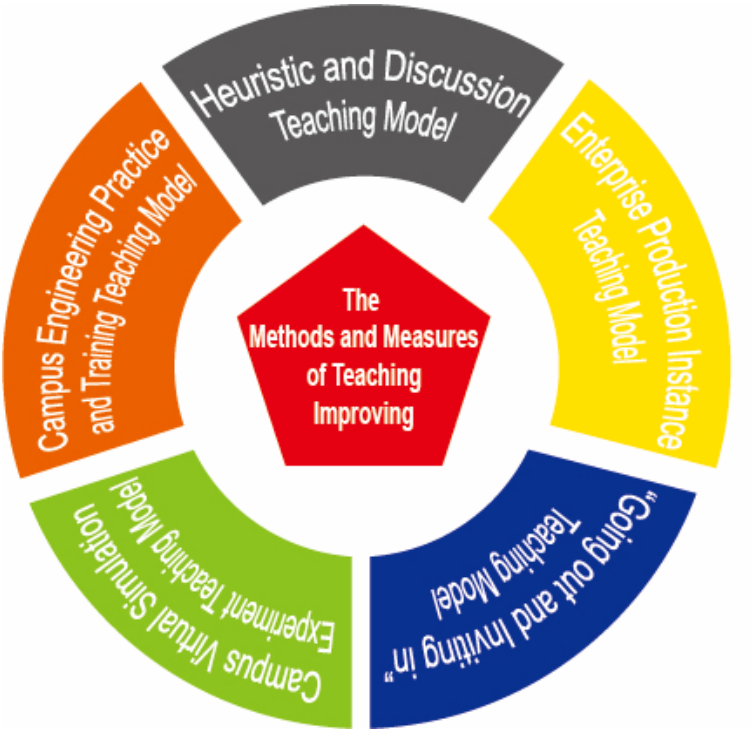

Figure 2. Reform measures of teaching methods and means.

5.1. Heuristic and Discussion Teaching Model

By implementing the heuristic and discussion-based teaching methods, the initiative and enthusiasm of the students can be mobilized for learning, and an ability to ask and

solve problems can be cultivated. In engineering courses, the assignments mainly consist of small test papers that stimulate the students' active thinking, and cultivate their ability to comprehensively apply knowledge and self-study skills.

5.2. Enterprise Production Instance Teaching Model

Based on their practical learning experience from the industry, the teachers can introduce new technologies used in industrial production process into the curriculum, highlighting the practicality of the content. As a result, the students can understand the principles and concepts in real examples. For example, the Pharmaceutical Technology course introduces the process of biological, chemical, and traditional Chinese medicine production, wherein typical examples come from the real production scenarios in pharmaceutical enterprises.

5.3. "Going out and Inviting in" Teaching Model

"Inviting in" means hiring part-time teachers from the pharmaceutical enterprises with strong practical engineering aspects as the main lecturers for professional courses, who can be responsible for teaching the contents that are closely related to production reality. Meanwhile, the theoretical part of the content can be taught by the school's professional teachers. In each semester, production technology experts from well-known pharmaceutical or cross-national pharmaceutical enterprise can be invited to the university to give special lectures on new pharmaceutical technologies for students.

"Going out" implies the content closely related to the pharmaceutical enterprise production scenes for professional courses that is arranged in the pharmaceutical enterprises with on-site learning. Herein, the enterprise engineering and technical personnel are invited to give on-site lectures to the students.

5.4. Campus Virtual Simulation Experiment Teaching Model

By utilizing the school's engineering training center which meets GMP standards and launching virtual simulation experiment, students should be allowed to personally operate and control the production equipment and become familiar with its working principles. This resolves the problem of not being able to operate equipment due to the mere industrial-visit of the pharmaceutical enterprises. After such training and simulation, the internship in enterprises can achieve the effect of twice the results with half the effort.

5.5. Campus Engineering Practice and Training Teaching Model

Practical teaching and engineering training can be launched by relying on the school's built-in engineering training center as an important training platform, which can allow the students to carry out engineering practice operations before going to the factory for internship. This helps in providing an essential guarantee for improving the students' engineering practical and innovative abilities.

6. Cultivation of Innovation Awareness and Ability

Cultivating innovation awareness and ability is an important aspect of the "New Engineering" reform. While strengthening the cultivation of practical engineering aspects, the cultivation of students' engineering innovation ability can be strengthened from multiple aspects, including laboratory openness, undergraduate innovation, entrepreneurship training, and participation in various academic competitions (such as the international "Internet Plus" university student innovation and entrepreneurship competition, the National College Student Pharmaceutical Engineering Design Competition). Meanwhile, regular invitations can be given to alumni and expert scholars who have achieved/provided outstanding contribution to scientific research to deliver academic lectures on scientific and technological innovation. Also, the technical engineers from pharmaceutical companies and pharmaceutical design institutes can be invited to give special reports on engineering innovation. The specific measures that can be taken are shown in Figure 3.

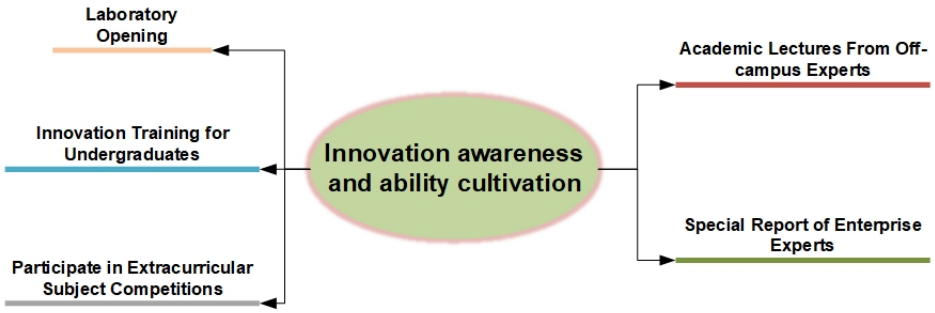

Figure 3. Measures of cultivating the innovative ability of college students.

7. Conclusion

With the implementation of the "New Engineering" reform and other professional construction initiatives, the quality of pharmaceutical engineering education in the School of Pharmacy, Jiangxi Science and Technology Normal University has significantly improved, and the influence and reputation of the specialties has been significantly enhanced. Herein, the students' engineering practical ability has been significantly enhanced and the overall satisfaction of the specialty has kept in high level. There is a shortage of graduates concerning the employment, and the selected candidates have been generally highly evaluated from the employers. Meanwhile, the level of professional construction has been significantly improved. The Pharmaceutical Engineering major of the Jiangxi Science and Technology Normal University has been rated as a first-class advantage specialty in Jiangxi Province in 2022, and has ranked first in the comprehensive evaluation of majors in Jiangxi Province for two consecutive rounds. Further, it has been approved as a five-star major in the Jiangxi Province.

Without doubt, the implementation of "New Engineering" is unmanageable without the participation of teachers. Teachers need to devote a lot of energy and time to education, and education-reform related work. It is a prerequisite for ensuring the construction of first-class specialty and the quality of talent cultivation needed by the

government management departments and schools. Relevant policies need to be introduced to encourage the teachers to voluntarily invest more energy into education and teaching.

8. Acknowledgement

This study was supported by the "New Engineering" Research and Practice Project of the Ministry of Education (Letter from the Department of Education and the Higher Education Bureau (2020) No.23) and Jiangxi Provincial Teaching Reform Research Project (JXJG-21-10-22).

References

[1] Lin J. The construction of China's new engineering disciplines for the future. Tsinghua Journal of Education, 2017 Mar; 38(2): 26-35.
[2] Yin DM, Shan YX. Practical research on the construction path of pharmaceutical engineering characteristic specialty in local colleges under the background of new engineering. Journal of Higher Education, 2021 Oct; 7(30): 36-41.
[3] Liang H, Zhou Y, Qin PY, Zheng GJ, Yuan QP. Building a New Mode of School-enterprise Cooperation Talents Training Based on Emerging. Higher Education in Chemical Engineering, 2021 Aug; 38(04): 120-124.
[4] Bai J, Zhang GS, Shi LL, Tao AL, Dai Y. Research on the Education and Training Mode of Outstanding Pharmaceutical Engineers in Application-Oriented Private Colleges Based on Emerging Engineering. Anhui Chemical Industry, 2022 Aug; 48(04): 130-132.
[5] Ye ZW, Li JZ, Chen Q. Research on the Training Mode of Applied pharmaceutical Engineering Talents under the Background of New Engineering. Pharmaceutical Education, 2022 Jun; 38(03): 19-22.
[6] Ni XC, Yang X, Lu Y, Kong WJ, Qu F, Meng R, Xu LJ, Sun HB, Zhao WH. Exploration on the Training Mode of Innovative Ability of Applied Engineering Professionals under the New Engineering Concept. The Theory and Practice of Innovation and Entrepreneurship, 2022 Nov; 5(23): 130-132.