Scholar Publishing Group
International Journal of Public Health and Preventive Medicine
https://doi.org/10.38007/IJPHPM.2020.010305
ISSN 2789-8377 Vol. 1, Issue 3: 50-56

Deep Integration of Innovation and Entrepreneurship Education and Pharmaceutical Engineering Education

Nitin Anand Shrivastava*

Keio University, Japan

**corresponding author*

Keywords: Innovation and Entrepreneurship Education, Pharmaceutical Engineering, Practice and Innovation

Abstract: Building a system of deep integration of innovation and entrepreneurship education and pharmaceutical engineering education to improve the practice and innovation of pharmaceutical engineering students and improve their ability to adapt to the development requirements of the pharmaceutical industry in the 21st century.

1. Introduction

As a strategic industry in the 21st century, the pharmaceutical industry belongs to a special industry with knowledge-intensive and innovative capabilities. The pharmaceutical engineering profession is the cradle for cultivating talents for the pharmaceutical industry. It requires that the cultivated talents should have the ability of engineering quality, innovation and entrepreneurship in order to adapt to the development of the industry. This requirement poses new challenges for the direction and objectives of the training of pharmaceutical engineering professionals: it can ensure that students can learn solid basic knowledge within the curriculum system, and at the same time, it can enable them to have the ability to innovate and start up, and timely track the pharmaceutical industry’s frontier development. Therefore, it is imperative to integrate innovation and entrepreneurship education in colleges and universities, and to provide corresponding research and practice specifically for the pharmaceutical specialty students.

2. The Status of Pharmaceutical Engineering Education

In the past 30 years of reform and opening up, China's pharmaceutical industry has developed rapidly. Pharmaceutical companies have successively reformed or expanded, introduced advanced foreign technology and equipment, and improved the overall level of China's pharmaceutical industry technology and equipment through digestion, absorption, and innovation. However, the rapid development cannot hide many problems faced by the pharmaceutical industry in China, such as small scale, outdated equipment, ageing varieties, low production efficiency, high raw material energy consumption, high cost, and weak competitiveness. The most important cause of these difficult situations is the lack of professional talents, especially the lack of pharmaceutical engineering talents. Compound talents who know not only pharmaceutical preparations, production processes, and quality control, but also know how to apply engineering technologies are almost blank. In order to adapt to the needs of personnel training in the new situation, in 1998, the Ministry of Education set up a pharmaceutical engineering program to speed up the training of pharmaceutical engineering professionals when adjusting professional settings in colleges and universities. The specialty is a new discipline that intersects mainly in pharmacy, chemical engineering, and bioengineering, also a leading discipline in chemical engineering and pharmaceuticals. In fact, the establishment of this specialty is not a unique situation in China. Many institutions in foreign countries have established the pharmaceutical engineering profession under the Engineering College or the School of Chemical Engineering since 1995. In the teaching of pharmaceutical engineering, the curriculum has changed several times. After many years of exploration and practice, pharmaceutical engineering has gradually become the core of the professional teaching. The main content of pharmaceutical engineering is the industrialized production technology of pharmaceuticals, that is, based on chemistry and engineering, research in the field of pharmaceuticals through chemical or biological reactions and separation and other unit operations, explore the basic principles of manufacturing drugs and realize industrial production engineering technology , Including research, development, amplification, design, optimization, technology and economics of new processes, new equipment, and GMP transformation.

3. The Problems Faced by the Professional Education Model of Pharmaceutical Engineering at Present

The pharmaceutical engineering major of our school is based on the original chemistry specialty. As can be seen from Table 1, it has been deeply influenced by the chemistry major in the initial major curriculum setting. After the students graduated, information from employers showed that the pharmaceutical professional technicians we trained had the same trend as those who graduated from early chemistry majors. They usually only understand the principles of drug synthesis or manufacturing rather than engineering applications, and it is difficult to adapt to the old products of drug manufacturers, the transformation of old workshops, the amplification of new products, and the design of new plants and new plants. This shows that the knowledge structure of graduates is irrational, leading them to quickly adapt to the company's requirements after leaving school, and companies have to spend a lot of time and money to retrain them. The direct cause of this phenomenon lies in the fact that our education model has certain defects and deficiencies. The most important one is that there is a big gap between the teaching of engineering knowledge points and the actual work.

4. Initiatives for In-depth Integration of Innovative Entrepreneurship Education and Pharmaceutical Engineering Education

(1) Strengthen the curriculum design content of pharmaceutical equipment. Science must be transformed into engineering before it can be transformed into productivity, and it can truly promote social progress. The importance of engineering knowledge teaching is evident. However, our training program still maintains the traditional training mode of traditional engineering education to a great extent, and the orientation of the curriculum is still more focused on the professional theory, and the trend of the academicization of professional courses becomes more obvious. This tendency will be even more prominent in the development of the school into a

comprehensive, research-based process. To this end, according to the contents of the four courses currently established, such as engineering drawings, pharmaceutical equipment, mechanical analysis, instrument analysis, chemical engineering principles, etc., according to the needs of the pharmaceutical engineering students in the future employment positions at any time to choose or update the teaching content. For example, in the teaching of "Principle of Pharmaceutical Equipment Machinery" and "Chemical Engineering Principles", pharmaceutical equipment, such as reaction tanks, heat exchangers, distillation towers, etc., are designed to increase students' perceptual knowledge and turn boring text on books into real devices. Doing so can not only cultivate students' engineering design ability, enable students to master the preliminary method of engineering design, deepen students' understanding of theoretical contents, but also strengthen engineering awareness. The design content of these courses was weakened in the previous teaching plan, and it is unfavorable to cultivate students' engineering awareness. Through the reform of these design courses, we can better reverse the bad habits of graduates who do not paint, do not look at construction drawings, and do not want to work in the first line of engineering technology.

(2) Develop a combination of social practice and production examples. In recent years, it has become increasingly difficult for students of pharmaceutical engineering and pharmacy to develop social practices. This has been influenced by the expansion of colleges and universities and the general implementation of GMP by pharmaceutical companies. On the other hand, the employer's demand for the actual operational ability of graduates has only increased. How to solve the contradiction between students' practical ability and social practice is a problem we face in the teaching process. Years of experience show that in the teaching process, we fully integrate knowledge of engineering knowledge and use more production examples from pharmaceutical factories to conduct teaching, such as the teaching of “Machinery Basics for Pharmaceutical Equipment”. We select appropriate unit operating equipment from the production facilities of each pharmaceutical factory as an example to explain to students, while deleting or reducing the contents of the purification workers to save school hours. These initiatives can strengthen the link between the course and the pharmaceutical industry, increase the intimacy of students in the profession and enhance the initiative of learning. In addition, in the teaching process, teachers should continue to strengthen students' awareness of strengthening social practice and encourage students to use the annual summer vacation time to find pharmaceutical companies for short-term internships, to understand the applied knowledge of theoretical knowledge in practical production, and to have content on books. A perceptual understanding, while accumulating actual production experience, can be more handy when looking for a job. Encouraging self-directed internships will also increase students’ initiative in learning, clarify the purpose of learning, increase the sense of urgency and responsibility, and increase self-confidence in employment. This kind of independent practice is a useful supplement to the school's unified organization of collective visits and internships.

(3) Reform professional experiment. Under the condition that the number of hours of engineering courses is limited, it is necessary to provide engineering students with as much knowledge as possible in engineering, and it is necessary to improve the teaching model of professional engineering courses in pharmaceutical engineering. The use of classroom teaching, factory internships, innovative experiments and self-designed multi-channel teaching models is the current direction of development. Compared with other majors, this specialty is characterized by a large number of professional experiments and long required academic hours. How to highlight engineering characteristics in professional experiments is the main direction for our exploration. For example, in the “tablet preparation and quality inspection” experiment course, we changed the way that the students were allowed to operate the single-press tablet machine to make tablets before the beginning. Instead, we first let the students understand the single-press tablet’s structure, familiar with the structure and function of the main components, so that each student to participate in the

demolition and assembly of the tablet press, combined with the "pharmaceutical equipment mechanical basis" content to answer students' questions. We have noticed that since teaching materials generally lag behind the pace of development of new technologies, it is often found in the teaching practice that there are a lot of disjointed contents. It is difficult for the students to leave a deep impression on the contents of these books that cannot be explained by teachers alone. The author believes that teachers can only give questions and requirements, and all other work is done by students themselves. Students are required to consult relevant materials in advance, determine the design of experimental programs, arrange the work of small components and the experimental process, and submit the required drugs and instrument demand lists. When the experiments are completed, submit the experimental report in the form of a small paper. A similar design experiment not only prompts students to come into contact with new technologies and new processes, but also enables students to initially understand the procedures and methods for conducting scientific research and design, and to prepare for future graduation designs.

5. Training Pharmaceutical Engineering Compound Talents

In recent years, the concept of “general education” has been proposed by the higher education sector. This is due to the reforms proposed by the early “specialist” training model that was incompatible with the times, social and economic development. The so-called general education is to emphasize the cultivation of talents with broad knowledge, solid foundation, wide professional qualifications and strong adaptability. The development of pharmaceutical engineering teaching has become a general trend in the direction of cultivating talented personnel with “a thick foundation, wide caliber, heavy practice, high quality, and creativity”. Science and technology belong to the category of culture from the perspective of human culture. Scientific culture and human culture are the cornerstones of human civilization. It can be said that the cultivation of compound talents and humanistic education are indispensable. Through humanities education, we can improve people's quality, enrich people's inner world, enrich people's life connotation, sublime people's ideological realm, and improve their personality. In the traditional teaching mode of the university engineering major in China, especially in the content of the course, it is mainly a single natural science theory and engineering technology knowledge; in addition to a few political theory courses, the humanities and social science courses are almost blank, and similar problems exist in the early training programs for the pharmaceutical engineering profession. This kind of overemphasis on the results of natural science education has made the education of humanities and social sciences, which is inspiring students' minds, cultivating students' creativity, enriching students' knowledge, and enhancing their sense of social responsibility, has not been well implemented. This has resulted in the knowledge of science and engineering college students. The single structure, especially manifested as the lack of managerial and social activities, and lack of knowledge of social life, is incompatible with the needs of the development of modern society. Therefore, we recommend schools to add social science courses such as “university language” to the public basic courses, and also set up social science management courses such as “pharmaceutical management” and “drug marketing” in the professional training programs. The introduction of the classic case analysis in the course can greatly expand the horizons of the students and expand their knowledge, so as to lay a solid foundation for the faster and better adaptation to society and work after graduation. The research on the reform of the teaching model of pharmaceutical engineering is a long-term task faced by teachers in this field. Only by continuously exploring teaching modes that are in line with actual production and in line with the training objectives of applied talents, can the teaching activities be carried out in all directions and in multiple channels , so that graduates of this major can become the backbone of technical business in the field of biopharmaceuticals and chemical pharmaceuticals at home and abroad after they embark on their work positions.

6. Experimental Analysis of Pharmaceutical Simulation

6.1. Simulation Object Model and the Simulation Conditions

At the experiment site, the multi-function extraction tank took water as the solvent extraction liquid to studied the temperature control of the liquid pressure, so the venting valve and the extraction pressure is close to atmospheric pressure, so the simulation model of the fuzzy control system analyzed in this chapter does not consider the influence of the tank pressure change on the liquid temperature in the tank. Because the field steam pipeline has a certain transmission distance, the opening adjustment of the steam control valve needs a relatively long transmission time t to affect the temperature of the pharmaceutical liquid in the site multi-function extraction tank, so there is a delay link. After the multifunctional extraction tank jacket enters the steam, the temperature of the pipe wall jacket is basically equal to the steam temperature t, After the heat conduction of the steel tank, the inner wall temperature is e. Temperature distribution in the tank wall is as follows:

$$t(x) = (t - e) / l \tag{1}$$

Among them, the L is the thickness of the extraction tank wall.

6.2. An Analysis of Pharmaceutical Production Temperature Control

Automatic control is a process capable of automatic operation or control of the machine or device according to the prescribed procedures. Simply put, control without manual intervention is automatic control. The following are the pharmaceutical production control table:

Table 1. Pharmaceutical manufacturing control rule sheet

NB	NM	NS	ZO	PS
PB	PB	PM	PM	ZO
PN	ZO	PS	SE	ND
PM	SZ	SD	EF	SA
SD	ED	PM	PS	NS

It can be drawn from the above table that some rules describe the large difference between the system and the given output, and have the increasing trend, increasing the proportion action to improve the dynamic response speed of the system, reduce the integral action to avoid greater overshoot, while slightly increasing the differential action to inhibit the system overshoot.

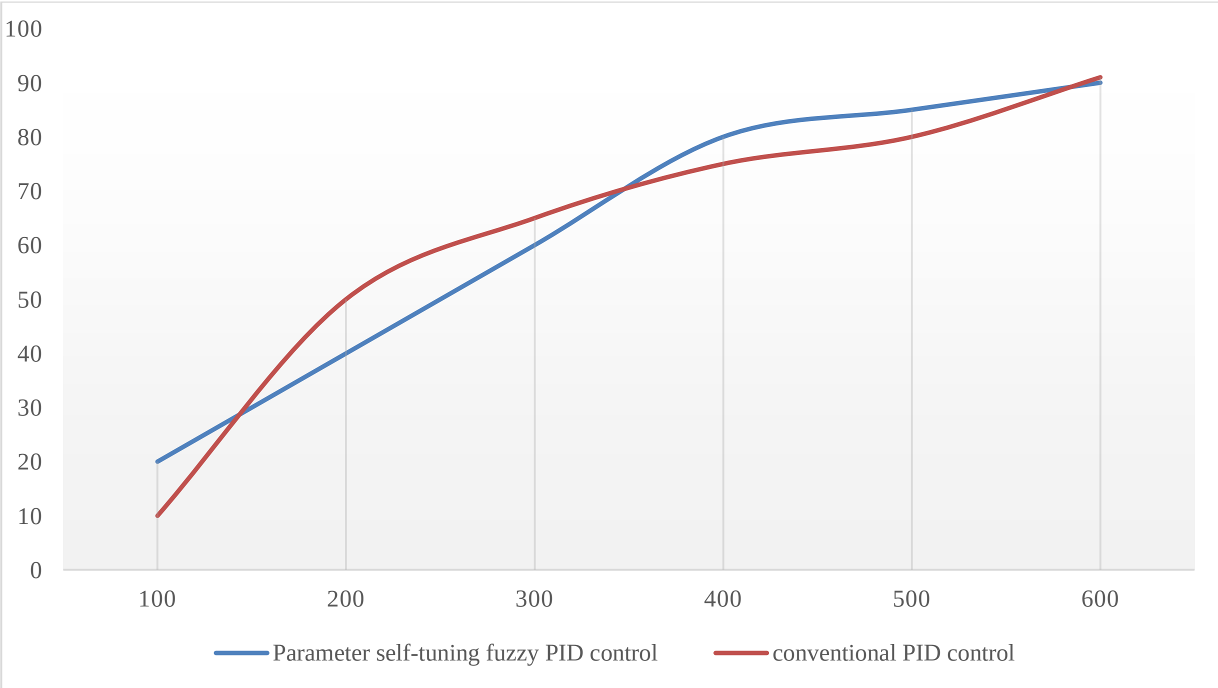

Figure 1. Extract the temperature control curve

Although the conventional PID control can almost meet the control demand under the parameters of the same system transfer function, for systems that can not directly establish accurate mathematical models and parameters will change with time for the temperature control of Chinese medicine extraction industry, the conventional PID control of the PID control parameters according to the transfer function in the control system cannot guarantee the control effect when the parameters of the established mathematical model change.

7. Summary

This article accurately grasps the “new normal” of China’s economic development and helps the country’s “National Entrepreneurship” call. Based on in-depth knowledge of reforms in innovation, entrepreneurship, and professional education at colleges and universities at home and abroad, the research content fully relies on the advantages of Shenyang Pharmaceutical University's pharmacy disciplines, closely integrated with the systematic and practical characteristics of the training of pharmaceutical engineering professionals. Integrate innovation and entrepreneurship education with professional education, and systematically study the engineering curriculum system, curriculum content, teaching methods, and evaluation methods for pharmaceutical engineering personnel training. Through practical research, a pharmaceutical engineering talent training system with innovative spirit and entrepreneurial ability has been initially formed.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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