Attempt to Train Compound Professional Talents

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\textbf{Abstract}. In order to solve the orientation problem of applied chemistry, according to the actual situation of the school, we should play multidisciplinary comprehensive advantage and train compound talents to make the students form three-dimensional networked knowledge structure. Use multidisciplinary advantages of comprehensive university, carry out a variety of extracurricular scientific and technological activities to expand students' horizons, guide students to apply chemical knowledge in chemistry, biology, environmental protection, materials and other fields, and flexibly use intellectual property concepts, so as to lay foundation for innovation and entrepreneurship. And put forward several principles to carry out students' extracurricular scientific and technological activities. After several years of practice, compound talents we've trained have got a good development in the actual work. The innovation is to broaden the field of vision to the combination of applied chemistry with other disciplines.

1. \textbf{Introduction}

With the implementation of transition to application-oriented school, as a traditional basic discipline, how does applied chemistry adapt to the new situation and how to cultivate useful talents for the local economic construction have become the focus and difficulty of teaching reform of applied chemistry. Applied chemistry is an applied science and engineering major between chemistry and chemical industry, but it is also a second-class discipline under the first-class discipline of chemical engineering and technology. It is the primary problem that many applied chemistry majors need to solve that how to accurately define the training direction and feature of applied chemistry and how to successfully find its difference from chemical industry major and give full play to the advantage of science.

Among over 750 colleges in China, there are 447 colleges having applied chemistry undergraduate major. These schools include colleges related to science, engineering, medicine, agriculture, forestry, military and teachers. The history and discipline background of these schools are not only not the same, but very different. How to build a characteristic applied chemistry major is the common problem faced by these colleges. Li Qun and others proposed that we should construct distinctive applied chemistry major based on "geographical advantages and principle advanced nature" and wide-caliber principle [1].

Domestic research in this area mainly focuses on the reform of the contents of chemical teaching itself [2]. Lin Rongguang proposed "to strengthen the construction of teaching staff, improve the level of scientific research, strengthen the practice teaching links" [3]. Wang Jun, etc. proposed to use their own industry advantages to develop a distinctive applied chemistry major [4]. Huang Zhongjing proposed that according to the local economy, develop applied chemistry training model in line with

\textsuperscript{*}Important project funded by education and teaching reform of Hebei University of Science and Technology; Corresponding author: Liu Mei, Hebei University of Chinese Medicine, E-mail: liumei196412@163.com
local characteristics [5]. Pan Lu, etc. Proposed that combine the growth experience of the major, and develop a distinctive applied chemistry [6]. Su Liqiang proposed that applied chemistry is an applied research-oriented major, rather than engineering-based major, it should focus on the development of instrumental analysis and application of organic according to the school's characteristics [7]. Xu Jia, etc. Proposed that the school’s applied chemistry should focus on "training" application-oriented professional talents who master the whole knowledge system from “material preparation, material separation, analysis and detection to performance evaluation and take analytical testing techniques and materials chemistry as their major direction” [8]

2. Research Purpose

The purpose of this research is to solve the orientation problem of applied chemistry. We propose that on the basis of the above research, we should strengthen the combination of applied chemistry major and other related majors to form knowledge structure of three-dimensional network, expanding the research and application scope of students of applied chemistry major.

College of science has three basic disciplines: applied mathematics, applied physics and applied chemistry. Because these disciplines focus on the basic theory, they give students the impression of pure theoretical research-centered and poor applicability when comparing to some applied majors. In fact, with the progress of modern science and technology, these basic disciplines’ connection with actual production and life becomes more and more close. Only to lay a solid foundation can students flexibly use basic knowledge and skills learned to solve a variety of practical problems in the actual work. As an old saying goes: learn physics and chemistry well, one will not be afraid to go anywhere!

Hebei University of Science and Technology is a comprehensive university. One of its predecessors is Hebei Light Chemical Engineering Institute, its chemical engineering and pharmacy major is the school's traditional major, which has stronger advantage. How to avoid weaknesses, give full play to the advantages of applied chemistry and train students with characteristics, is the problem that applied chemistry major must solve if it wants to develop.

3. Solutions to the Problem

The solution to the orientation problem of applied chemistry is to "explore the horizon and provide a broad stage with multidisciplinary advantages". In the practice of many years, we have summed up some laws, including the principle of students to choose topics of extracurricular scientific and technological activities. While ensuring the teaching of basic knowledge and basic skills, choose appropriate topics based on the following principles and optimize students’ knowledge structure, increase the training of students’ intellectual property rights strategy and its application in innovation and entrepreneurship, so that students can form three-dimensional networked new knowledge structure, and help students to form three-dimensional knowledge network through a variety of extracurricular scientific and technological activities.

3.1 Principles of Topic Selection

Carry out students’ amateur science and technology activities, adhere to taking students as the main body, guide students to choose their own topics, participate in competitions such as Challenge Cup, college students innovation and entrepreneurship competition. At the same time, select experienced teachers as instructor to guide them on research, topic selection, experiment plan designing, and experimentation, experimental data processing, writing of professional papers, application and protection of intellectual property rights.

According to the characteristics of different students, they can choose to carry out social research project or technology production project. However, due to the particularity of chemistry major, students need to follow the following principles when screening topics:

3.1.1 Safety

Chemistry major has a certain degree of risk. The traditional teaching content has been selected carefully after years of practice, and can ensure the safety of teaching process. But students’
innovative entrepreneurial activity is different from traditional teaching content. Therefore, when selecting topics, students must consider the safety of the experimental program and whether it involves national controlled chemicals, try best to avoid the use of flammable and explosive chemicals, prohibit the use of highly toxic or other dangerous reagents and reactions related to special conditions such as ultra-high temperature, high pressure.

3.1.2 Feasibility

Students are subject to constraints of professional knowledge, time, capital and management experience when carrying out extra-curricular activities. It is different from social innovation and entrepreneurship activities, so students need to carefully select practical and feasible projects.

First select project with appropriate difficulty and appropriate workload, avoiding causing too much impact on the normal learning of students. At the same time, we also need to choose the appropriate grade of students. Generally we build teams based on principles of sophomore-oriented and supplemented by other grades of students. The freshmen have just entered the school and only began to study basic courses. They are not suitable to participate in such scientific and technological activities or as main body. Junior and senior students are facing entrance examination and graduate internship and other practical problems. In addition, it needs certain time to participate in activities and competitions. Therefore, they are also not suitable for participation in such activities.

The limitation of funding is also an important consideration in selecting the topic. Although the country and school vigorously promote the extracurricular scientific and technological activities of university students, the actual support is relatively small. Therefore, the limitation of experimental funds is also an important factor to be considered.

3.1.3 Controllability

Students need the guidance of teachers when carrying out innovative entrepreneurial activities, so try to choose the direction and areas related to the research direction of teachers. After all, students’ energy and experience are very limited. All the experimental process must be carried out under the guidance and control of the instructor to avoid unnecessary waste and accidents.

3.1.4 Sustainability

Choose a comprehensive and versatile technology as the basis for students to carry out innovative entrepreneurial activities. Guide students to master the technology and flexibly use it in many systems, so as to ensure the sustainability of innovative entrepreneurial training system.

3.2 Optimizing structure of knowledge

3.2.1 Cultivating Students' Intellectual Property Rights Strategy and Its Application in Creative and Enterprise Ability

Innovation generally refers to putting forward new ideas or assumptions in technology field or some specialized knowledge fields, which needs corresponding specialized knowledge. However, entrepreneurship is different from the innovation process. It is related to how to protect the intellectual property and transform the intellectual property into productive forces.

Firstly, professional training is essential, through which students will understand the law and keep the law. At the meanwhile, teaching students the Patent Law is necessary. Students should know the necessary condition to apply for a patent, the differences among utility model, patent for an invention and appearance design. After finished the innovation, students should learn to apply for the appropriate patent form by adopting the Patent Law, such as the utility model, patent for an invention and appearance design. It is of use to guide students to get familiar with the Patent Law, abbey the regulations of the Patent Law and apply for the patent.

Applying for a patent is a process involving high technical content. Students we have guided have applied five utility model and patent for invention sequence, among which three utility models and two patents for invention have been authorized.

At present, our country is eager to encourage total innovation, and individual cities and provinces carry out new policies to support innovation one after another. If innovation consciousness can be integrated into students’ mind, they will provide vital force with innovation consciousness to the society continuously.
3.2.2 Making Full Use of Multidisciplinary Comprehensive Advantage, and Cultivating Students’ Three-dimensional Knowledge Structure Net

With the rapid development of Internet of Things technology, huge impacts have happened on all walks of life. The traditional concept, definite division of labor industry formed by traditional education has been totally changed. New-type applied talents who know multidisciplinary knowledge and able to use modern network technology are urgently needed. There are numerous talents majored in natural sciences in the College of Science. The technology advantage of developing Internet of Things is clear.

The same theory can also be used in the following aspects, monitoring and controlling the PH value in reaction system, controlling the ion concentration, testing and controlling the system pressure, color changing and so on.

After a complete system composed by monitoring-transmitting-counting-modeling-simulating-solving-controlling-feedback, this system can be guided to students and used in different chemical reaction process. Therefore, the sustainable development of students’ innovation and entrepreneurship activities will be achieved.

4. Preliminary Result

In recent years, we have organized students to take part in colorful extracurricular science and technology activities, through which students’ visions have been broadened and good foundation has been set up for their future development.

In the year of 2015 and 2016, we organized students to take part in “the Ninth College Student Energy Saving and Emission Reduction Social Practice and Technology Competition”. Many projects have been launched successfully, such as “Program Research on the Isolation Technology of Carbon Dioxide and Methane in Biogas”, “Energy Saving and Emission Reduction of Vegetable Greenhouse in the Eyes of Chemical Engineering workers”, “Strengthening the Resource Utilization Degree of Corn Stalk, Upgrading the Energy Saving and Emission Reduction in Hebei Villages”. Among which “Seeing the Measures of Energy-saving and Emission Reduction of Vegetable Greenhouse from the Point of Chemistry" had achieved the school-level second prize in the “Rongwei New Energy Cup” “Ninth College Student Energy Saving and Emission Reduction Social Practice and Technology Competition”.

In the extracurricular scientific and technological activities launched unitedly by Hebei University of Chinese Medicine, we guide students adopt the synthetic principle of super absorbent polymer on the basis of fully analyzing the chemical composition and organizational structure of corncob, which can be used as the assumption to make bedding for rodent animal. This project has been selected by the university national-level funding project of innovation and entrepreneurship of college students. In the process of completing the project, we have obtained a national invention patent licensing, applied for a patent for an invention and published an academic paper on the core journals. The project “Corncob Turns to Animal Bedding" has won the grand prize in the First College Student Innovation and Entrepreneurship Annual General Meeting in Hebei. On this basis, we have compiled the entrepreneurship planning for Xinxing Animal Bedding Science and Technology Co., Ltd. This product has won the second prize in “Chuangqingchun" Hebei Undergraduate Business Plan Competition. In the process of completing the project, students have obtained the all-round exercise, such as literature review, chemical experiment, company operations, marketing, applying for and operating intellectual property.

Through our training, students have formed a comprehensive and three-dimensional knowledge system and become interdisciplinary talents. It has established a better foundation for the future development. They will make progress soon when entering the service.

Now several outstanding graduates’ representatives will be listed: 2005 Dong Zhipeng, after graduated 10 years required for investment of 60 million Yuan, established Hebei Lansheng Biotechnology Co., Ltd. and became the general manager. This company has become a leading
company in pesticide industry. Zheng Dongliang, a graduate in 2006 has entered into Shijiazhuang Pharmaceutical Group Corporation Butylphthalide Phamax Corporation, now he is the regional manager of Hebei. Liu Guicheng, a graduate in 2007, started his work in Academy of Sciences of South Korea. Wang Lei, graduate in 2009, entered Chinese Academy of Sciences Physical and Chemical Center.

5. Conclusion

We have summarized that multidisciplinary comprehensive application is able to have stacking effect on the development of students. We integrated and optimized the three majors, applied mathematics, applied physics and applied chemistry in the College of Science and determined to set up a new project group. We adopted the sensor technology of the physics major and tested the different parameters in the chemical reaction process. All the test data were transmitted through the internet, which belongs to the applied mathematics (specialty of information technology). We did the statistical analysis of the modern information technology, did the real-time record management and control, provided the further intelligent control and monitoring of the chemical reaction process. The students of applied chemistry have been cultivated into the interdisciplinary talents with modern, synthetical, three-dimensional knowledge system. On this basis, we will provide long-term extracurricular scientific and technological activities platform for the students of applied chemistry.

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7. References


