

# Construction of Biological Experiment Curriculum System in the Context of Innovation and Entrepreneurship Education

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**Abstract:** Innovation and entrepreneurship education is an important direction for the current reform of higher education and should be included in the professional talent training plan and the construction of the biological experiment curriculum system. Specific measures include in-depth excavation of the connotation of biological experiment teaching courses from the perspective of talent training, building an innovation and entrepreneurship biological experiment curriculum system guided by the needs of social development, establishing a comprehensive and diversified platform for practice and innovation, and constructing a teaching team that integrates innovation and entrepreneurship education and professional education.

**Keywords:** Innovation and entrepreneurship education; Curriculum system; Biological experiment

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## 1. Connotation of innovation and entrepreneurship education

The theoretical research and practical exploration of innovation and entrepreneurship education emerged in the United States. Thus far, a system of multi-subject participation involving government, schools, and social institutions has been formed, and its corresponding support and guarantee system is relatively sound<sup>[1]</sup>. Innovation and entrepreneurship education in China started late. With the popularization of the higher education management system, the number of college graduates has increased year by year, and the employment of college students has become one of the issues of the highest social concern in recent years<sup>[2]</sup>. Measures such as actively carrying out innovation and entrepreneurship education, comprehensively constructing the curriculum system, and improving the entrepreneurial ability of college students are important to serve the innovation-driven national development strategy<sup>[3]</sup>.

Innovation and entrepreneurship education is an educational concept and model that takes cultivating students' innovative spirit and entrepreneurial awareness and skills as the basic value orientation<sup>[4]</sup>. The innovation and entrepreneurship curriculum system refers to the collection of multiple components of the curriculum system (curriculum objectives, structure, content, implementation, guarantee, etc.) under the value concept of innovation and entrepreneurship education, and the all-round planning and overall promotion of

innovation and entrepreneurship courses <sup>[5]</sup>. The deep integration of innovation and entrepreneurship education and professional education, especially the reform of the professional curriculum system, is a new hotspot in the reform and research of innovation and entrepreneurship education <sup>[6]</sup>.

## **2. Status quo of biological experiment curriculum system in the context of innovation and entrepreneurship education**

The laboratory of colleges and universities is an essential teaching place for organizing high-level experimental teaching and cultivating students' practical skills and innovative spirit, as well as an important base for the cultivation of innovative and entrepreneurial national talents <sup>[7]</sup>. Experimental teaching can cultivate students' practical skills and innovation ability, which is an important part of improving the quality of education and teaching in colleges and universities <sup>[8]</sup>.

Students majoring in biotechnology should not only complete the systematic study of theoretical knowledge in biology, chemistry, chemical engineering, and other disciplines in four years of university, but also carry out a series of basic experimental courses in biochemistry, microbiology, cell biology, and molecular biology. The issue of linking the reform of the experimental curriculum system with innovation and entrepreneurship education needs to be solved urgently in practical teaching. There are various deficiencies in the traditional biological experiment teaching in the process of building an innovation and entrepreneurship experimental curriculum system.

First, the connotation of the curriculum is inadequately explored. The current teaching content of innovation and entrepreneurship in different courses is relatively similar, which leads to the lack of practicability of this course and cannot play a role in helping students innovate.

Second, the integration of resources is insufficient. It only relies on classroom teaching to convey innovation and entrepreneurship knowledge to students and uses teaching materials as the basis for teaching, which lacks the expansion and integration of innovation and entrepreneurship knowledge.

Third, the learning path is relatively simple. With the development of digital education, the national virtual simulation experiment platform is currently being utilized; however, it is not yet sufficient to fully support the expansion of high-level innovative and entrepreneurial talent training channels.

Fourth, the construction of quality teaching staff is insufficient. The teachers lack enterprise or industry background and the overall teaching level of innovation and entrepreneurship needs to be improved urgently.

## **3. Reform measures of biological experiment curriculum system in the context of innovation and entrepreneurship education**

Biological experiment teaching must effectively integrate the concept of innovation and entrepreneurship education into professional experimental instruction. This involves aligning professional knowledge with the needs of innovation and entrepreneurship talent development, expanding curriculum objectives, optimizing course structures, and reforming experimental projects. By stimulating students' interest in experiments and enhancing their experimental skills, we can create favorable conditions for fostering innovation and entrepreneurship among students <sup>[9]</sup>.

### **3.1. Exploring the connotation of biological experiment teaching courses from the perspective of talent training**

The biological experiment course covers a number of core laboratory courses for biology students, meeting

the needs of enterprises and industries for high-quality and practical talents. On the one hand, it is necessary to enable students to deepen their understanding of professional theories and achieve the effect of interdisciplinary and integration of various professional knowledge. On the other hand, from the design of experimental protocols and experimental operation to result analysis, more attention is paid to strengthening students' industry awareness and innovative spirit and cultivating their problem-oriented, critical, and creative thinking.

### **3.2. Constructing a biological experiment curriculum system of innovation and entrepreneurship based on the needs of social development**

In the context of the rapid development of digital education, the curriculum construction should focus on the following modules. First, basic experimental courses and general education experimental courses are created to help students understand the framework of innovation and entrepreneurship, mobilize their interest in innovation, and strengthen their entrepreneurial thinking. Second, it is necessary to create professional experimental courses that combine the characteristics of life sciences to enable students to optimize their knowledge structure while laying a good foundation for professional learning and leading students to participate in entrepreneurial practices related to their majors. Third, a practice platform is established, such as cultivating students' entrepreneurial practical skills with the help of laboratories and relying on entrepreneurship and entrepreneurship projects to strengthen students' awareness of participation. Fourth, the development direction of different types of students should be considered in the setting up of personalized experimental courses, providing differentiated guidance by college and grade <sup>[10]</sup>.

### **3.3. Building a comprehensive and diversified platform for practice and innovation based on online and offline modes**

First, we should build offline platforms. On the one hand, it is of great significance to strengthen students' innovative thinking by efficiently applying their own resources, providing them with innovative practice space, fully meeting their needs for extracurricular innovation activities, and integrating students, teachers, and scientific research teams to participate in project research.

On the other hand, it is necessary to strengthen cooperation with government organizations and enterprises, jointly build an entrepreneurial practice platform, organically integrate entrepreneurship education and project incubation, and rely on multiple forces to support students to carry out innovation and entrepreneurship practical activities. In essence, the main purpose of creating an offline platform is to provide students with entrepreneurship education, practices, and services, enhance the ability of entrepreneurial interaction, and establish correct employment awareness through cooperation with government organizations and enterprises, so as to quickly integrate into social practice.

Second, we should build online platforms. In line with the wave of digital education, the advantages of information technology provide a solid guarantee for the creation of a curriculum system for innovation and entrepreneurship education, using the Internet as a medium to integrate various high-quality resources <sup>[11]</sup>. For example, using a virtual simulation experiment platform, Yanhe classroom, and massive open online course to provide students with timely learning content and diversified guidance services, so as to facilitate students to better grasp the knowledge of innovation and entrepreneurship.

### **3.4. Building a team of teachers who integrate innovation and entrepreneurship education with professional education**

Innovation and entrepreneurship education strengthens the training and education of teachers' theoretical knowledge, practical skills, project guidance, etc., and improves their innovative thinking and skills by guiding

students in experiments or competitions at all levels. At the same time, through cooperation with enterprises, professionals such as senior technicians, entrepreneurs, outstanding innovative and entrepreneurial individuals, etc. can be hired as part-time teachers. This approach promotes the two-way exchange between academic faculty and senior technical personnel from the industry, gradually forming a teaching team that embodies both entrepreneurial spirit and professional expertise. Together, this full-time and part-time team can effectively collaborate to nurture entrepreneurial talent.

## **4. Construction effectiveness of biological experiment curriculum system in the context of innovation and entrepreneurship education**

### **4.1. Effectiveness of teaching model construction**

In recent years, we have incorporated innovation and entrepreneurship education into the professional talent training plan. Through professional experimental courses, school/municipal college students' innovation and entrepreneurship projects, open experiments, and other course platforms, we integrated scientific and technological innovation and experimental teaching reform. We have also built an open and diversified innovation and entrepreneurship system, and established and optimized a multi-level and multi-modular innovative practice teaching curriculum system with skill training as the core, with the combination of virtual and real.

Taking the courses "Cell Biology Experiment" and "Molecular Biology Experiment" as examples, they are professional basic experimental courses in the field of life sciences; from the perspective of course objectives, they both emphasize the cultivation of compound talents with entrepreneurial awareness, innovative spirit, and entrepreneurial ability. From the perspective of curriculum content and implementation, the following reform measures have been made:

- (1) The experimental syllabus was integrated and optimized, the confirmatory experiments were reduced, the classical experiments were retained, and the basic knowledge and basic ability training were emphasized.
- (2) Comprehensive design experiments were increased, focusing on cultivating students' innovation and cultivating the ability to find and solve problems.
- (3) Combining virtual and real, digital means such as a virtual simulation experiment platform were used to diversify students' abilities in innovation and entrepreneurship.
- (4) General and applied cell and molecular biology experiments are conducted in open laboratories for the entire university. For example, teachers from different colleges (School of Life Sciences and School of Medical Technology) can apply their experience in scientific research practice, school-enterprise cooperation, and integration of science, engineering, and medicine to teaching, so as to help students better grasp the theoretical and practical knowledge of innovation and entrepreneurship.

### **4.2. Collaborative education of various departments**

Focusing on the cooperation of various departments, the faculty comes from different colleges and further promotes innovation and entrepreneurship from multiple levels of colleges, functional departments, and scientific research laboratories. It builds an interconnected and top-down innovation and entrepreneurship education atmosphere and continuously improves the effect of innovation and entrepreneurship education in mutual cooperation.

### **4.3. Establishment of a shared professional education experimental platform**

Through school-enterprise cooperation, a practice platform for innovation and entrepreneurship education and

professional education is built. According to their own characteristics and resource advantages, the company's capital and technical advantages are maximized to realize the complementary advantages of schools and enterprises, and jointly build a collaborative innovation and entrepreneurship center guided by innovation and entrepreneurship, led by professional education, and combined with the real enterprise environment, so as to accumulate resources for the depth and breadth of innovation and entrepreneurship education.

## Disclosure statement

The authors declare no conflict of interest.

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