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Innovation and Practical Exploration of the Second Classroom Training Model for Biotechnology

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Abstract

Based on the dual backgrounds of building an innovative country and promoting the development of emerging engineering disciplines, cultivating college students' innovative and practical abilities has become a core task of higher education. While the first classroom, as the main channel for knowledge impartment, is undoubtedly important, the second classroom plays an irreplaceable role in stimulating students' interests, enhancing their practical skills, and shaping their innovative thinking [1]. Based on the teaching reform practice of the biotechnology major at Qilu University of Technology, we deeply analyze the common problems existing in the construction of the second classroom in colleges and universities, especially for bioengineering-related majors, such as disconnection from the first classroom, insufficient resource investment, and tendencies towards formalization and entertainment. On this basis, a new second classroom training model centered on "in-depth integration, resource integration, interest-driven approach, and integration of competitions and teaching" is proposed. This model adopts specific measures including the establishment of curriculum integration teams, the formulation of joint teaching plans, the construction of teacher-student communication platforms, the implementation of personalized curriculum menus, and honor-based incentives. It aims to build a systematic and scientific second classroom system, so as to improve the comprehensive quality and innovative abilities of students majoring in biotechnology effectively, and provide a reference path for the reform of professional talent cultivation in similar science and engineering universities.

Keywords

Second Classroom; Biotechnology; Training Model; Innovative Ability; Teaching Reform; Integration of Production, Education and Research.

1. Introduction

With the increasingly fierce global scientific and technological competition, the demand for innovative talents has reached an unprecedented level. College students, as the backbone of the future science and technology, their innovative ability cultivation is directly related to the strength of the country's core competitiveness. However, the traditional education model, which mainly focuses on knowledge indoctrination in the first classroom, is gradually showing its inadequacy in cultivating students' ability to solve complex engineering problems and stimulating their awareness of independent innovation. Therefore, the second classroom, as an extension and supplement to the first classroom, has received increasing attention for its educational function [2]. With its flexible forms, wide-ranging content, and student autonomy, it has become a key platform for training students' practical abilities, collaborative spirit, and innovative thinking.

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As a cutting-edge interdisciplinary subject, biotechnology is developing rapidly, and it has high requirements for talents' practical abilities and innovative qualities. However, the construction of the second classroom for Biotechnology majors in many domestic colleges and universities is still in the exploratory stage at present. And there are many common problems. Firstly, the attention paid to it is insufficient. The second classroom is often regarded as an "extra activity", and there is a significant gap in resource guarantees such as teachers, funds, and venues compared with the first classroom. Secondly, the integration with professional education is low. The content of activities is often not closely related to the knowledge system of core courses, failing to form an effective teaching synergy. Thirdly, the activity system is loose and lacks systematic design, which easily falls into formalism of "holding activities just for the sake of activities", and even shows a tendency of "over-entertainment", failing to truly serve the goal of talent cultivation [3].

In view of this, this study takes the biotechnology major of Qilu University of Technology as a specific research object, based on its existing “Outstanding Engineers" program”, Entrepreneurship College, and various discipline competitions. It aims to construct and practice a set of effective innovative training models systematically for the second classroom to solve the above problems, realize the synchronous development of the first and second classrooms, and improve the quality of talent cultivation comprehensively.

2. Analysis for the Current Second Classroom System

By sorting out the current situation, we summarize the core difficulties in the construction of the second classroom for the biotechnology major in this study.

2.1. Ambiguous Positioning and Lack of Resources

The development of the second classroom is encouraged by the policy, while the focus of teaching management is still obviously on the first classroom actually. Students are usually required to give priority to the course learning in the first classroom. Additionally, professional teachers have low participation in the second classroom. This leads to a lack of academic depth and professional guidance in activities which reduce the educational effect greatly.

2.2. System Segmentation and Content Simplification

The activities of the second classroom are not organically connected with the teaching syllabus of the first classroom, failing to form a virtuous cycle of "theory-practice-re-theory". The activities of the second classroom are relatively single, which often limited to lectures and simple club activities. The second classroom lacks in-depth integration with the professional characteristics of biotechnology currently. The majority of students participate in extracurricular activities with the aim of obtaining credits, resulting in insufficient internal motivation and difficulty in ensuring the activity effect [4].

2.3. Lack of Evaluation and Incentives

A scientific and effective evaluation system for the achievements of the second classroom has not yet been established. Students' efforts and gains are difficult to be quantitatively recognized, which frustrates their enthusiasm for participation. At the same time, there is a lack of incentive mechanisms related to students' vital interests such as scholarships and selection for merit-based honors. As a result, the "value" of the second classroom in students' minds is insufficient.

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3. Construction Path of the Innovative Training Model for the Second Classroom

Based on the above problems in the construction of the second classroom for the biotechnology major, we design a set of reform plans characterized by "four integrations" in this study.

3.1. In-depth Integration of Curriculum Content: Breaking down Classroom Barriers

A "Curriculum Integration Team" composed of professional leaders and backbone teachers has been established. Its core responsibility is to conduct an in-depth analysis of the knowledge points and ability requirements of the first classroom, and design second classroom activities that are accurately connected with them accordingly. For example, after the theoretical course of Molecular Biology and Molecular Biology Experiments, a practical project on "CRISPR Gene Editing Technology" can be arranged in the second classroom; during the study of Biomedical Analytical Chemistry and Biomedical Analytical Chemistry Experiments, simulated training on "molecular diagnosis" can be introduced; and during the study of Biological Products, simulated training on "optimization of protein purification process" can be introduced. The team compiles a Guide for the Integration of the Second Classroom and the First Classroom, which clarifies the connection points and development directions of each semester and each course, so that the second classroom could truly become a "practice ground" and "deepener" of theoretical knowledge [5].

3.2. Integration and Optimization of Teaching Resources: Building a Support Platform

The internal laboratory resources, scientific research equipment, and teacher resources of the college are fully explored and integrated to establish a "Second Classroom Resource Library". At the same time, external resources have been actively expanded, and stable cooperative relationships will be established with biotechnology enterprises and scientific research institutions. Real research and development projects and industrial technical problems are introduced as practical topics for the second classroom. A "tutorial system" has been implemented to encourage outstanding professional teachers and enterprise engineers to serve as instructors for the second classroom, which provided students with full-process professional guidance from idea generation to practice.

3.3. Accurate Stimulation of Students' Interests: Implementing Personalized Empowerment

Through regular questionnaires, student seminars, and other forms, the dynamic grasp of students' interests and development needs is achieved. Based on the survey results, a "Personalized Second Classroom Curriculum Menu" will be designed and provided, covering multiple modules such as "Scientific Research Training Camp", "Innovation and Entrepreneurship Workshop", "Industry Skill Certification", and "Discipline Competition Reserve Team". Students can choose independently according to their own interests and career plans in order to realize the transformation from "being required to participate" to "being willing to participate" [6]. Through the above measures, their internal motivation is maximally stimulated.

3.4. Incentive Mechanism and Achievement Consolidation: Integrating Competitions and Teaching, Guided by Honors

The second classroom is deeply integrated with high-level discipline competitions such as the "Challenge Cup" National College Student Curricular Academic Science and Technology Works Competition, and National College Students' Life Science Competition, so as to promote learning

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and innovation through competitions. The certification and reward system for the achievements of the second classroom is established, with honorary titles such as "Innovation Star" and "Practice Pioneer". The performances in the second classroom are included in the evaluation system for scholarship assessment. This can not only effectively enhance students' sense of participation and accomplishment, but also provide a diversified evaluation basis for the quality of talent cultivation.

4. Effects and Specific Achievements

After the implementation of this project, the college has basically formed a replicable and promotable "Second Classroom Training Model for Biotechnology Majors", including a systematic implementation plan, management system, and evaluation system. The students' innovative practical abilities and professional identity have been significantly improved, and the number and quality of awards obtained by students in high-level discipline competitions have been steadily enhanced. A stable and high-level team of instructors for the second classroom has been built, and a series of high-quality second classroom activity cases and teaching resources have been formed.

5. Conclusion

The second classroom is an important position for cultivating outstanding engineering and technological talents in the new era. For a highly applied major like biotechnology, constructing a second classroom training model that is deeply integrated with the first classroom and has strong resource guarantees, can fully stimulate students' potential. It is an inevitable choice to conform to the trend of higher education reform and improve the quality of talent cultivation. The reform ideas and practical paths proposed in this project are based on specific problems, emphasizing systematic design and operability. They not only play a direct role in promoting the construction of the biotechnology major at Qilu University of Technology, but also provide valuable references for the teaching reform of related majors in other science and engineering universities. Future research will continue to track the implementation effect, constantly optimize the model, and strive to achieve more fruitful results in the practice of cultivating innovative talents.

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