



Exploration and Practice of Innovative Talents Training Mode Integrating Medicine and Engineering

Xuan Ji ¹, Wei Gong ^{2*}

¹Faculty of Nursing, Changzhi Medical College, Changzhi 046000, Shanxi Province, China

²School of Medical Information Engineering, Guangzhou University of Chinese Medicine, Guangzhou 510006, Guangdong Province, China

Corresponding Author: GONG Wei, gongwei@gzucm.edu.cn

Abstract. Cultivating high-quality innovative talents is the core of higher education, and developing students' creativity is the main direction of teaching reform. Based on the practice and exploration in recent years, this paper puts forward the basic principles of establishing an innovative training system for majors integrating medicine and engineering in medical colleges. It provides new ideas and implementation approaches for the establishment of a new system of biomedical engineering talent training from four aspects: curriculum teaching system reform, practical teaching link design, the second classroom and optimizing the structure of teachers.

Keywords: Innovative talents; Biomedical engineering; Cultivation mode; Reform

1 Introduction

Cultivating high-quality innovative talents is the core of higher education, and developing students' creativity is the main direction of teaching reform ^[1]. Cultivating students with innovative consciousness and ability is the historical mission entrusted to higher education in the new era. The future medical science will develop along with the combination of medicine and engineering technology. Especially in the manufacturing of medical devices, the development of engineering technology and the upgrading of instruments will continue to promote the development of medicine. Therefore, it is an urgent task for "Made in China 2025" to research and develop key high-performance medical devices with China's independent intellectual property rights through the combination of medicine and engineering.

Only by implementing creative education and teaching can students' creativity be effectively cultivated ^[2]. Based on the practice and exploration in recent years, the project team proposed the basic principles of establishing an innovative talent training system for biomedical engineering in medical colleges, and provided new ideas and implementation approaches for the establishment of a new training system for the students majoring in integration of medicine and engineering from four aspects: cur-

riculum teaching system reform, practical teaching design, the second classroom and optimizing the structure of teachers.

2 Problems

At present, a lot of medical colleges in China have set up majors integrating medicine and engineering, and explored the training mode of majors of this type in different degrees. However, in terms of innovation, no particularly influential achievements have yet been formed. The specialty of integrating medicine and engineering determines that it is difficult to explore innovative training methods.

(1) The understanding of the importance of innovative education has not been really in place. With the development of higher education, more and more attention has been paid to innovative education, but innovative education has not yet become the common action of college teachers and students. The reason is that the understanding of managers, teachers and students has not been really in place.

(2) The "innovative" talent training model has not been fundamentally established^[3]. Over the years, innovation has gradually become an important indicator of talent training objectives. Various policies, systems and measures have been introduced continuously, but the talent training mode has not been fundamentally changed. First, various policies, systems and measures have not formed a systematic integrity, but are only partial amendments and supplements based on the traditional training model; Second, the form is more important than the essence, and has not played a significant role in the training of "innovative" talents.

(3) Innovative education lacks strong goal orientation^[4]. Although the society generally pays attention to innovative education, due to the lack of goal orientation, innovative education has not been really implemented. One of the reasons is that for a long time, innovative education has not really been included in the scope of teachers' teaching performance assessment, and has not been linked to innovative education in terms of teachers' post appointment and professional title promotion; On the other hand, for students, the traditional assessment system and method of single value evaluation still maintain inertia in the teaching field, becoming the "bottleneck" of implementing quality education and cultivating "innovative" talents, and hindering the improvement of students' ability and quality.

(4) Innovative education lacks qualified teachers^[5]. After years of efforts, teachers in colleges and universities have been greatly improved in terms of knowledge updating and educational level. However, there are still quite a few teachers who have not experienced the training of practical work and have not directly participated in the research and development and improvement of products, that is, the proportion of "double-quality" teachers is still low, so they lack experience in innovative education, and naturally it is difficult to adapt to innovative education.

It is a complex systematic project for colleges and universities to cultivate innovative talents. According to the viewpoint of system theory, a whole is composed of many interrelated elements, each of which has its specific function. The system itself

is a complete whole, and can also exist as a subsystem of a larger system. The system is not a simple addition of elements, but an optimized combination of the whole [6].

Systematic thinking requires us to grasp the whole and make a comprehensive investigation in the whole. Integrity, hierarchy and dynamics are the basic characteristics of the system, and the interaction between these three characteristics is an organic combination, which provides a new perspective for us to study the cultivation of innovative talents in colleges and universities. To cultivate innovative talents, colleges and universities need to establish the concept of "student-centered" and cultivate students' innovative personality and consciousness; Constructing the education model with students as the main body; Respecting students' individuality and implementing individualized education; Building an innovative teaching staff; Build a good campus culture and enrich extracurricular scientific and technological activities and social practice.

3 Methods

A highly interdisciplinary discipline requires students to master rich theoretical knowledge and have strong professional skills, practical ability and innovation ability. The cultivation of "innovative" talents, first of all, is to define the goal orientation of innovative talents on the basis of optimizing the training objectives, and establish a diversified talent training model and an education and teaching model student-centered with teachers as the leading role. Based on the characteristics of innovative talents, practical education and second classroom education will play a more important role in talent training. The quality evaluation standard system and assessment method of "innovative" talents will also be reformed accordingly. The foundation of cultivating "innovative" talents lies in education, which requires a team of teachers with "innovative" characteristics to match with it, and the cultivation of "innovative" talents needs a sound organizational management system to guarantee.

3.1 Deepen the teaching reform and improve the education and teaching model student-centered with teachers as the leading role.

Teaching method is the main factor that restricts the development of students' innovation ability [7]. The cultivation of "innovative" talents is inseparable from reform and innovation. With the innovation of educational concepts, we will promote the comprehensive innovation of teaching content, teaching methods and teaching technology. The teaching method must realize the transformation from the traditional teacher centered knowledge imparting type to the teaching method that combines knowledge imparting and innovation, practice, teacher-student interaction. The main goal is to mobilize students' independent learning, stimulate students' thirst for knowledge and creativity.

(1) Strengthen the cultivation of quality courses, follow the three construction stages of "excellent", "model" and "quality courses", and form a three-level quality course construction system of "national, provincial and school level". Discover, create

and persistently cultivate courses with the characteristics of biomedical engineering in the practice of quality courses construction, and improve the support system for the cultivation of innovative talents.

(2) Deeply promote the reform of teaching contents and methods. In the course teaching of cultivating innovative biomedical engineering students, we should appropriately use foreign original textbooks, appropriately introduce bilingual teaching, and use a large number of inquiry based teaching methods such as discussion, heuristic, case based teaching, so that students can master the latest knowledge, understand the latest development trends of the discipline, and keep the level and structure of students' knowledge synchronized with the advanced level of discipline development. Only in this way can students achieve innovation and breakthrough on the basis of the existing level. By opening special lectures, forums and scientific research training courses, students can enter scientific research laboratories or research groups as soon as possible, introduce scientific research activities and social practices into the teaching process through various ways, and actively explore new ways of teaching scientific research training courses.

(3) To fully mobilize students' enthusiasm and participation in learning, we should coordinate the relationship between traditional teaching methods and the application of modern educational technology in teaching methods. On the basis of popularizing multimedia teaching, make full use of modern teaching methods based on the Internet, expand teaching resources, stimulate students' awareness of participation in teaching, expand teaching time and space, and effectively improve teaching quality.

3.2 Strengthen practical education and establish a practical teaching mode integrating simulation in school and practice outside school.

Practical education is not only a teaching method, but also a teaching link. It is an important channel for students to transform knowledge into ability and apply theory to practice by taking the cultivation of practical innovation ability as the goal and adopting teacher guidance and students' active participation as the main teaching methods. Therefore, strengthening practical education is an important link in cultivating students' "innovation" ability.

(1) On the basis of inheriting the traditional content, the innovation is carried out to realize the overall optimization of the practical teaching content system through the integration of the original practice links. The four links of curriculum practice, investigation practice, paper design and extracurricular practice are established as the focus, and the four progressive steps of public practice, discipline practice, professional practice and comprehensive practice are taken as the level. The practice teaching is continuous for four years, A practical teaching system that integrates practical teaching into the whole learning process of the undergraduate stage.

(2) The practice teaching content system should be constructed with the ability cultivation as the main line, and the practice teaching content should be constantly updated and optimized according to the social development and discipline progress. Scientifically design the experimental teaching syllabus, reduce the contents of demonstration and verification experiments, and increase the contents of comprehen-

sive, designed, open and innovative experiments, so as to ensure that students receive sufficient training in basic skills and innovation ability in the experimental teaching link. Expand students' independent experiments. Students will choose their own experiment direction, complete the experiment design under the guidance of teachers, determine the content, methods and steps of the experiment, and complete the whole process of the experiment independently, so as to enhance students' ability to carry out creative experiments.

(3) Graduation design is an important link to cultivate students' practical ability and innovation ability. In order to ensure and improve the quality of the graduation project, the application and review system of topic selection shall be strictly enforced, and it is clearly required that the topic selection shall be closely combined with the scientific research topic, production practice, social work, etc., and the update rate of the topic selection of the graduation project shall be improved to ensure the progressiveness and novelty of the topic.

(4) Strengthen the cooperation between industry, university and research, and develop a new model of cooperation between industry, university and research [8]. According to the idea of integrated construction of student internship and employment base, establish strategic cooperation with enterprises and institutions, especially medical equipment R&D, manufacturing enterprises and hospitals, gradually expand the strength and depth of cooperation, and create more opportunities for students to combine with social practical work, production and scientific research.

3.3 Strengthen the second classroom and establish the second channel for cultivating "innovative" talents.

"The second classroom" is an effective way and carrier of "innovation" education, which highlights its advantages in terms of flexibility of teaching organization, openness of management, universality of resource integration, autonomy of resource allocation, etc [9]. In practical activities, the training process of team composition and ability of students is interdisciplinary and interdisciplinary, with knowledge overlapping, infiltration and complementation, which is comprehensive. This kind of educational purpose and effect will influence students imperceptibly, and gradually internalize them into their innovative quality, enhance their desire for knowledge, stimulate their innovative consciousness and thinking, and improve their innovative ability.

(1) Make full use of internal and external education resources to organize high-quality "Innovation and Entrepreneurship Report and Forum", "Entrepreneurship Class", "Successful Alumni Entrepreneurship Report" and other activities for students. Use the rich knowledge and unique insights of experts, professors and entrepreneurs and the successful entrepreneurial process to motivate students, encourage students, and enhance their confidence and determination in innovation.

(2) Establish a management system for students' scientific research projects, increase funding, encourage students to carry out scientific research, and publish high-quality academic papers. Encourage teachers to absorb undergraduates to participate in project research. Provide more academic lectures and academic discussion opportunities for students. Focus on supporting the construction of students' academic

associations and make full use of the discipline advantages of departments to develop academic associations.

(3) Actively organize students to carry out colorful extracurricular science and technology competitions, encourage students to practice, and actively participate in design innovation competitions, so that students can participate in scientific research, production and other work more and earlier, and increase the opportunities to cultivate practical ability and innovation spirit ^[10].

3.4 Optimize the structure of teachers and establish an innovative teaching team.

"Innovative" teachers should have high professional ideals and sound personality characteristics, innovative educational outlook, complete knowledge structure and professional skills, high teaching monitoring ability and stronger management art. They can absorb the latest educational scientific information, creatively discover and put forward the problems existing in real education and teaching, and creatively plan, organize and implement educational and teaching activities. They have unique insights and found effective new laws and methods of education and teaching, can practically use educational research achievements, are good at combining teaching work with research projects, and can use modern information technology to improve education and teaching efficiency.

(1) Universities should strengthen the training of young and middle-aged teachers, further optimize the structure of the teaching staff, gradually form the group advantage of high degree, high professional title, high level, and low age. Improve the relevant systems of teachers' further study in well-known universities at home and abroad to lay a solid knowledge foundation and complete knowledge structure. Track the frontiers of disciplines and economic and social development. Improve the teaching skills and professional level of young teachers through multiple channels. At the same time, teachers are encouraged to go to government agencies, enterprises and public institutions to carry out social practice or temporary training; For practical teachers of some professional courses, they should be encouraged to work with enterprises and hospitals to extract teaching content suitable for teaching requirements from their actual work.

(2) Introduce talents from well-known universities at home and abroad, strive to form an academic team that meets the needs of the university's positioning and discipline construction. Gradually establish a practice system for newly recruited teachers, which requires newly introduced teachers to have years of scientific research or social practice experience, and to be a prerequisite for innovative teachers.

4 Results

University leaders attach great importance to teaching reform, and the university has issued a series of policies and documents to support teaching reform. The university thoroughly implements the scientific concept of development, takes "collaborative

innovation to strengthen the school" as the goal, takes improving the quality of education and teaching as the core, deepens the teaching reform as the driving force, takes the coordinated training of talents as the guidance, takes the coordination between talents training subjects as the main form, relies on specific construction projects, focuses on project cultivation and construction, highlights the management of project construction process, and improves the effectiveness of project construction, Increase the application and promotion of project construction achievements, and actively cultivate high-level projects. Every year, the university organizes all departments to actively apply for quality engineering construction projects and higher education research and reform projects. Through these measures, the education and teaching quality of all majors in the school has been significantly improved.

Students have participated in the "Internet+" college student innovation and entrepreneurship competition, the "Challenge Cup" National College Student Series science and technology academic competition, the national college student electronic design competition, the national college student biomedical engineering innovation design competition, and the national college student program design competition for many times. By participating in these competitions, we can cultivate students' ability to consult materials, self-study, analyze and solve problems, comprehensive design and debugging, scientific and technological paper writing, and cultivate students' ability to integrate theory with practice, solidarity and cooperation spirit, and innovative consciousness.

5 Conclusions

Through the implementation of the project, guided by the discipline direction, the teaching content and curriculum system have been reformed, and the curriculum has been optimized and integrated. By 24-hour open laboratory and strengthening the practice, students' innovative thinking and innovation ability have been greatly improved.

In combination with the professional characteristics of biomedical engineering, a relatively complete training mode for professional talents has been established, which is based on inter school cooperation, school enterprise cooperation, resource sharing, and subject oriented development.

Through the implementation of this project, we will train senior engineering and technical talents with solid basic knowledge, strong practical operation ability, innovation awareness and innovation ability for medical units at all levels, medical instrument companies, scientific research structures and universities.

Acknowledgement

This work was supported by Higher Education Teaching Reform Project of Guangzhou University of Chinese Medicine in 2021 with Grant No.56 and Youth Research Project of Guangzhou University of Chinese Medicine in 2022 with Grant No. 202207.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lei JH, Huang M. The Training of China's Top Innovative Talent: Practice, Dilemma and Optimization—A Case Study of the Training Practice of Some China's First-Class Universities [J]. Journal of Shanghai Normal University (Philosophy & Social Sciences edition), 2022,51(04):126-135.
2. Hu J. Measurement Dimension and Evaluation Demonstration of Creative Thinking from ISA2021 [J]. Journal of Tianjin Academy of Educational Science,2021(02):23-28.
3. Dong ZF. Alliance With Practical Departments: The Reform Path of Talent Training Model in Ordinary Colleges and Universities [J]. Contemporary Education Sciences, 2018(01): 68-71..
4. Chen L, Shi DF. The policy logic and practice path of higher education's modernization in the new era [J]. Journal of Higher Education Management, 2021,15(01):97-106.
5. Su RY. Research on innovation and entrepreneurship education in colleges and universities in the era of popularization of higher education [J]. Journal of Innovation and Entrepreneurship Education, 2020, 11(06):30-38.
6. Shi L. The basic idea and educational reflection of complex system[J]. Educational Science Research, 2013(07): 13-20.
7. Wang H. The Influence of Classroom Teaching on Development of College Students' Innovative Ability--Based on the Observation of 184 Undergraduate Classroom Teaching in Research Universities [J]. Journal of National Academy of Education Administration, 2021(10):86-95..
8. Li WQ. Exploration and Practice of "Three-Zone Collaborative Innovation" Ideological and Political Education in Colleges and Universities-A Case Study of South China University of Technology, 2022, 24(03):115-122.
9. Zeng JX, Song D. Exploration on the Training of the Core Competitiveness of College Students Based on the Second Classroom [J]. Education and Teaching Research,2018,32(02):64-72+126.
10. Zan XS, Xu RD, Yu DS. Research on the Cultivation Mode of Undergraduate Innovative Talents Based on the Discipline Competition [J]. Education Modernization, 2020, 7(29):26-29.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

