Practice and Exploration on Innovation Mode of Industry-Education Integration for Biomedical Engineering Specialty in Universities

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Abstract: In the biomedical engineering industry, it is urgent to solve the problem of how to adapt the professional education in universities to the needs of the industry. This article focuses on the innovation mode of Industry-Education Integration of biomedical engineering specialty in universities. By combing the relevant theories of Industry-Education Integration, this article analyzes the current situation and problems of Industry-Education Integration by using theoretical analysis and other methods. The study found that the existing talent training objectives are not well connected, the participation of enterprises is insufficient, the construction of teachers is lagging behind, and the sharing of resources is blocked. Based on this, this article proposes to build an innovative model framework with the principle of demand-oriented, win-win cooperation and sustainable development, covering the objectives, contents and guarantee system, and expounds the key elements such as the deep cooperation mechanism between schools and enterprises, the reform of curriculum and practice teaching, and the construction of double-qualified teachers. It aims to provide an innovative path for the Industry-Education Integration of biomedical engineering specialty in universities, improve the quality of professional education, and cultivate high-quality talents that meet the needs of the industry.

1. Introduction

With the rapid development of science and technology, the field of biomedical engineering is innovating at an unprecedented speed [1]. Biomedical engineering, as a multidisciplinary specialty, plays an important role in the medical and health industry [2]. From the research and development of advanced medical devices to the clinical application of cutting-edge biomedical technology, it is inseparable from the support of this major [3]. However, with the rapid development of the industry, biomedical engineering education in universities is facing new challenges and opportunities.

To some extent, the traditional college education model is out of touch with the actual needs of the industry [4]. On the one hand, the theoretical knowledge of students trained in universities is relatively solid, but their practical operation ability and ability to solve practical engineering problems need to be improved. On the other hand, the new technology and new demand of the industry can't be fed back to the teaching in universities in time, which leads to the low adaptability between the talent training in universities and the industrial demand [5]. In this context, Industry-Education Integration has become the key path to solve these problems.

The purpose of this article is to deeply explore the innovative mode of Industry-Education Integration of biomedical engineering specialty in universities, so as to effectively improve the quality of professional education and cultivate high-quality talents that meet the needs of the industry. Through the research on the innovation mode of Industry-Education Integration, it is expected to provide an effective path for the cultivation of biomedical engineering professionals in universities. This can not only enhance students' practical ability and employment competitiveness,

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but also help universities to optimize the professional curriculum system and improve the overall teaching level. Furthermore, it is of great significance to promote the development of biomedical engineering industry and promote the transformation of scientific and technological achievements.

This article will use the method of literature research to sort out the relevant research results and practical experience; By theoretical analysis, the theoretical basis of Industry-Education Integration and the special requirements of biomedical engineering specialty for Industry-Education Integration are deeply analyzed. On this basis, the innovative Industry-Education Integration model is systematically explored, hoping to provide useful reference for educational practice in this field.

2. Industry-Education Integration theory of biomedical engineering specialty in universities

Industry-Education Integration means the deep integration of industry and education. It is not a simple form of school-enterprise cooperation, but an all-round and deep-seated collaborative education mechanism [6]. Under this mechanism, the resources and technology of industry are closely combined with the education and teaching resources of universities, and the education and teaching process is optimized with the guidance of industrial demand, so as to realize the seamless connection between personnel training and industrial demand. Its core connotation lies in breaking the barriers between education and industry and promoting the deep cooperation and interaction between the two sides in personnel training, technological innovation and resource sharing.

Biomedical engineering specialty has obvious interdisciplinary nature, which combines multidisciplinary knowledge such as biology, medicine and engineering, which determines that its talent training needs a compound knowledge structure [7]. Furthermore, this major is practical, and students should not only master solid theoretical knowledge, but also have the ability to apply theory to practical medical engineering problems. In addition, its comprehensive characteristics require students to integrate multidisciplinary knowledge and carry out innovative product development and technology application [8]. These characteristics put forward special requirements for Industry-Education Integration, which requires the close cooperation between industry and universities, to jointly formulate talent training programs and build a practical teaching system.

The theory of human capital emphasizes the important role of education in economic growth, and holds that improving the quality of workers through education can be transformed into economic benefits [9]. In the Industry-Education Integration of biomedical engineering, high-quality talents trained by universities can inject vitality into industrial development, promote industrial upgrading and create economic benefits. The theory of collaborative innovation emphasizes that all innovative subjects can share resources and complement each other's advantages through cooperation, and jointly overcome the innovation problems. In the process of Industry-Education Integration, universities and enterprises give full play to their respective advantages, jointly carry out scientific research projects and jointly build practice bases around the goals of technological innovation and personnel training in the field of biomedical engineering, so as to achieve coordinated development. These theories provide a solid theoretical basis and guiding direction for Industry-Education Integration of biomedical engineering specialty in universities.

3. Present situation and problems of Industry-Education Integration of biomedical engineering specialty in universities

3.1. Analysis of the current situation

At present, biomedical engineering majors in universities have made many efforts in Industry-Education Integration and achieved certain results. In terms of curriculum, some universities began to try to integrate industry-related content, such as adding medical device regulations, medical product design and other courses to enhance students' understanding of industry norms and actual product design [10]. In terms of practical teaching, most universities have established on-campus laboratories to provide students with basic practical operation platforms. Furthermore, some universities have cooperated with enterprises to establish off-campus practice

bases, so that students have the opportunity to get in touch with the actual production environment of enterprises.

The forms of school-enterprise cooperation are also increasingly diversified, from simple student internships and lectures by enterprise experts to cooperative projects in Industry-University-Research and joint laboratories [11]. For example, some universities cooperate with medical device enterprises to carry out scientific research projects and jointly develop new medical equipment, which has promoted the transformation of scientific research results to some extent. In order to present the present situation more intuitively, take some representative universities as examples, and make Table 1:

Table 1 Investigation Survey on the Current Status of Industry-Education Integration in Biomedical Engineering Programs at Selected Universities

University Name	Percentage of Industrial Content in Curriculum	Duration of On-campus Practical Teaching (Semesters)	Number of Off-campus Internship Bases	Number of University-Enterprise Cooperative Research Projects (Last Three Years)	Number of Lectures Given by Enterprise Experts (Last Three Years)
University A	20%	1.5	5	3	10
University B	15%	1	3	1	6
University C	25%	2	8	5	15

Table 1 intuitively shows the situation of some key indicators of Industry-Education Integration in different universities, reflecting the differences in the promotion degree of Industry-Education Integration among universities.

3.2. Existing problems

There is a deviation between the training goal of biomedical engineering professionals in universities and the actual needs of the industry. Universities pay attention to imparting theoretical knowledge, and the curriculum system is relatively slow to update, which fails to reflect the latest technology and development trend of the industry in time. What the industry needs is compound talents who not only know medical knowledge, but also have engineering practice ability and innovative spirit, and are familiar with industry regulations and market demand. This difference in goals leads to the fact that students trained in universities often need a long time to adapt to the requirements of enterprise work after entering the enterprise.

Although there are various forms of school-enterprise cooperation, the depth and breadth of enterprises' participation in Industry-Education Integration still need to be improved. Most enterprises only stay in shallow cooperation, such as providing internship positions and holding lectures, and are not enthusiastic about participating in deep-seated links such as the formulation of talent training programs, curriculum development and practical teaching guidance in universities. This is mainly because enterprises are worried that too much participation will increase operating costs, and there is a contradiction between the training cycle of talents in universities and the short-term benefit needs of enterprises.

The proportion of "double-qualified" teachers in the faculty of biomedical engineering in universities is low. Most teachers have profound academic background, but they lack practical work experience in enterprises, so it is difficult to integrate industrial practical cases into teaching, which leads to the disconnection between teaching content and practical application. Furthermore, the mechanism of introducing talents with rich practical experience from enterprises as teachers is not perfect, and enterprise talents face many policy and management obstacles when they teach

part-time in universities.

There are many obstacles in resource sharing between universities and enterprises. Universities have rich scientific research equipment and academic resources, but it is difficult for enterprises to use them effectively; Enterprises have advanced production equipment, technology and project experience, but they have not fully shared them with universities. For example, the updating of laboratory equipment in universities often lags behind the actual production equipment of enterprises, and students can't get in touch with the most cutting-edge technology and equipment in the industry on campus. In addition, the information communication between universities and enterprises is not smooth, which makes it difficult for the two sides to form an effective docking in resource sharing.

4. Construction of Industry-Education Integration innovation mode for biomedical engineering specialty

4.1. Principle of innovation mode

Demand-oriented principle: closely focus on the demand of biomedical engineering industry for talent knowledge, ability and quality, adjust and optimize the talent training program in universities to ensure that the trained students can quickly adapt to the requirements of industrial posts.

The principle of win-win cooperation: it emphasizes that universities and enterprises should share resources, complement each other's advantages and develop together in the process of Industry-Education Integration. Universities improve teaching quality and scientific research level with the help of enterprise resources, and enterprises obtain high-quality human resources and technical support by participating in talent training.

Principle of sustainable development: build a dynamic adjustment mechanism, continuously optimize the Industry-Education Integration model according to the industrial development trend, technological innovation and market changes, and ensure its long-term effectiveness and adaptability.

4.2. Mode framework

The innovative Industry-Education Integration model is mainly composed of target system, content system and guarantee system. The target system is clear, and the core goal is to cultivate compound innovative talents who adapt to the development of biomedical engineering industry. The content system covers curriculum reform, practical teaching optimization, teacher team construction and so on. The guarantee system includes policy support, school-enterprise cooperation mechanism, quality assessment and other elements to ensure the smooth operation of the model.

4.3. Key elements

Table 2 Division of Labor in Developing the Talent Cultivation Plan for the Biomedical Engineering Program through University-Enterprise Collaboration

Stage	University Responsibilities	Enterprise Responsibilities
Preliminary Research	Conduct industry theoretical research and analyze development directions	Collect job requirements and clarify talent quality requirements
Plan Development	Build the curriculum framework and determine theoretical teaching content	Provide practical teaching suggestions and clarify key points for competence cultivation
Plan Implementation	Responsible for theoretical teaching and on-campus practical teaching	Arrange internship positions and assign mentors to guide practical activities
Effectiveness Assessment	Assess students' academic performance	Assess students' practical skills and professional competence

Establish a regular communication and coordination mechanism between schools and enterprises,

regularly hold joint meetings, and jointly discuss major issues such as talent cultivation and scientific research cooperation. In terms of talent cultivation, enterprises are deeply involved in the formulation of talent cultivation plans for universities. Table 2 shows the division of labor for talent development projects jointly developed by schools and enterprises:

The school integrates course content, breaks disciplinary boundaries, constructs a modular curriculum system, and increases the proportion of cutting-edge industry knowledge and practical cases. At the same time, the school strengthens practical teaching and constructs a multi-level practical teaching system including basic experiments, professional training, enterprise internships, and graduation projects, ensuring that the proportion of practical teaching credits is not less than 40% of the total credits.

In the construction of a dual teacher team, the school encourages university teachers to work in enterprises and accumulate practical experience. In addition, the school hires senior technical and management personnel from enterprises as part-time teachers, enriches the teacher team, and establishes a reasonable teacher assessment and incentive mechanism to enhance the enthusiasm of teachers to participate in the integration of industry and education.

5. Conclusions

In this article, the innovation mode of Industry-Education Integration of biomedical engineering specialty in universities is deeply studied, and the following conclusions are drawn. At present, although the Industry-Education Integration of this major has made progress, it faces many problems. There is a deviation between the talent training goal and the industrial demand, and the curriculum system is not updated in time, so it is difficult for students' practice and innovation ability to meet the needs of enterprises. Enterprises' participation in Industry-Education Integration is not deep enough, and most of them stay in shallow cooperation, and the motivation for deep cooperation is lacking. There is a shortage of "double-qualified" teachers, and teaching is out of touch with practical application. There are obstacles to resource sharing, and it is difficult for universities and enterprises to complement each other. It is of great significance to build an innovative model for these problems. Based on the principle of demand orientation, the model framework defines the core goal of talent training, and provides a systematic solution for Industry-Education Integration by updating the curriculum, strengthening practice, building teachers and other content systems, combined with policy support and other security systems. Among them, the deep cooperation mechanism between schools and enterprises urges the two sides to cooperate closely in the whole process of talent training; The reform of curriculum and practice teaching effectively improves students' practice and innovation ability; The construction of double-qualified teachers ensures the close combination of teaching and industrial practice.

It is expected that the innovative model proposed in this article can provide useful reference for the practice of Industry-Education Integration of biomedical engineering specialty in universities, promote the deep integration of education and industry, cultivate more outstanding talents to adapt to the development of biomedical engineering industry, and further enhance the overall competitiveness of biomedical engineering in China.

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