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Research on Biopharmaceutical Talent Cultivation Assessment Based on OBE Model

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Abstract: *With the advancement of science and technology and the global prevalence of COVID-19, the biopharmaceutical talent cultivation has become increasingly important and played a more prominent role. The traditional cultivation model which is teacher centered and focuses on theoretical and textbook teaching, as well as classroom teaching, can no longer meet the talent cultivation needs of the biopharmaceutical industry. This paper is to analyze the main problems in the current cultivation of biopharmaceutical talents and explores the necessity of introducing the concept of outcomes-based education (OBE) into the cultivation of biopharmaceutical talents. This paper makes a further research directed towards the biopharmaceutical development needs, setting goals for cultivation of biopharmaceutical talents, exploring new ways to carry out biopharmaceutical teaching activities, proposing strategies for constructing an assessment system for biopharmaceutical professionals under the OBE cultivation model, and providing theoretical basis and implementation paths for cultivating high-quality talents in biopharmaceutical major.*

Keywords: *OBE; Biopharmaceutical; Talent cultivation; Assessment*

1. Introduction

Biopharmaceutical is a key planning and development area in the *National "Healthy China 2030" Plan Outline*, playing a crucial role in solving people's life and health issues, energy and ecological environment protection, and other fields. China's biopharmaceutical industry has made tremendous contributions to economic construction and social development after years of development. In the past decade, with the development in the combination of biology and modern technology, the vaccines, genetically engineered drugs, gene diagnosis and treatment, antibody diagnosis and treatment, and cell therapy become popular in the industry. The related enterprises are also developing in an increasingly large-scale manner. However, in stark contrast, there is a shortage of biopharmaceutical talents, especially applied talents with innovative abilities. In addition to the long training cycle of biopharmaceutical talents, the talent cultivation in colleges and universities is still centered around teachers, and theoretical teaching, classroom teaching, and textbook teaching, which are also important reasons. In case colleges and universities fail to comprehensively and developmentally anticipate the direction of biopharmaceutical development, and the teaching content and methods of teachers deviate from the progress of biopharmaceutical enterprises and industries, it will result in the ability and quality of talents in biopharmaceutical major cultivated by colleges and universities not meeting the needs of the industry. Therefore, even though there is a surplus in the total number of talents in biopharmaceutical related majors, there is still a shortage of talent due to structural imbalances. Biopharmaceutical is a discipline with strong experimental ability, practicalness, and applicability. The basic theoretical and experimental operation abilities, practical application abilities, and innovative design abilities in biopharmaceutical are all necessary for future talents. In this context, the cultivation model of teachers actively teaching while students passively learning, limited to classroom theoretical and experimental teaching, and limited practical teaching activities severely constrains and hinders the innovative development of China's biopharmaceutical industry from large to strong[1]. Therefore, it is urgent to conduct in-depth investigation and research on the problems in the cultivation of talents in biopharmaceutical major in China, reform the cultivation methods, and cultivate innovative biopharmaceutical talents satisfying market demand as soon as possible.

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2. The main problems in the cultivation of talents in biopharmaceutical class majors

This paper investigates and studies the talent cultivation plans of two undergraduate majors in biology in two universities in Guangdong Province (Biotechnology at the School of Life Sciences, SUN YAT-SEN UNIVERSITY, and Biopharmaceutical at the College of Life Science and Biopharmaceutics, Guangdong Pharmaceutical University) with reference to publicly available data, and analyzes the main research issues.

2.1. The quantity and quality of practical teaching are relatively low

Setting of talent cultivation program of biotechnology major at SUN YAT-SEN UNIVERSITY (Figure 1). There are a total of 44 credits for public courses, accounting for 26.7%; 100 credits for professional courses (theory + experiment), accounting for 60.6%; 21 credits for practical courses (scientific research training + internship), accounting for 12.7%. The experimental courses at SUN YAT-SEN UNIVERSITY include basic experiments, comprehensive experiments, and biological field internships, while practical courses include scientific research training and graduation internships. The characteristic courses for scientific research training start in Grade 2, offered every semester. Setting of talent cultivation program of biotechnology major at College of Life Science and Biopharmaceutics, Guangdong Pharmaceutical University (Figure 2). 39 credits for public courses, accounting for 26%; 92 credits for professional courses (theory +experiment), accounting for 61%; 18.5 credits for practical courses (professional expansion + internship), accounting for 13%. Experimental courses are basic and comprehensive experimental courses within the professional curriculum. The practical courses include a professional expansion course conducted in Grade 3 of the College of Life Science and a graduation internship in Grade 4.

According to the comprehensive survey and research results, it is known that the cultivation of undergraduate talents in biopharmaceutical class majors mainly focuses on course teaching still composed of theoretical and experimental teaching, accounting for the largest proportion, with theoretical teaching hours accounting for over 50% and practical teaching activities accounting for a low proportion, less than 20%. In addition to limited quantity, the problem of practical teaching also manifests in the lack of types and low quality. The existing practical teaching still focuses on graduation projects and internships for fourth year students, especially experimental research based on basic scientific research projects on campus, which may result in students' learning output abilities not being effectively realized. The specific reasons include: Firstly, most of the school internship instructors lack experience in working and collaborating with enterprises, and are unable to provide resources to understand and participate in enterprise training. Secondly, due to the limited funding and scale of schools and laboratories, it is impossible to provide hardware and software for multiple students to conduct research skill training simultaneously. Thirdly, internships are often offered to students in multiple majors at the same time, and instructors are unable to provide personalized and expanded teaching tailored to their cultivation needs. Through the analysis on the above cases, it is indicated that the quality of practical courses in biopharmaceutical majors still needs to be improved.

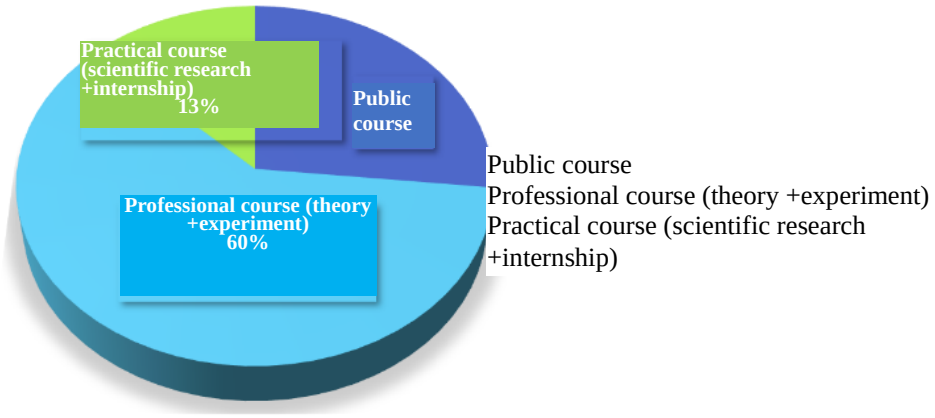

Figure 1: Credit hour distribution of biotechnology major at SUN YAT-SEN UNIVERSITY

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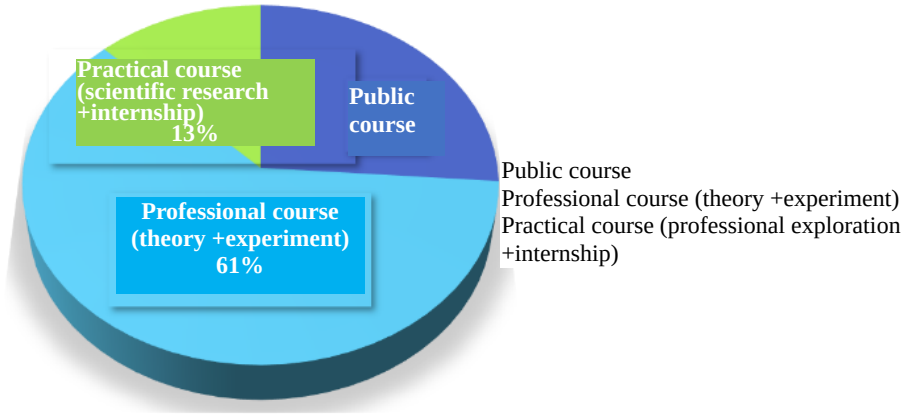

Figure 2: Credit hour distribution of biopharmaceutical major at Guangdong Pharmaceutical University

2.2. The teaching content does not match the progress of the biopharmaceutical industry

With the rapid development of information technology such as big data, the knowledge and technology updates of biopharmaceuticals are also getting faster and faster. What is inconsistent with this is that teaching in biopharmaceutical colleges and universities still relies mainly on classroom teaching and textbook teaching, and students' learning paths are mainly from teachers' teaching. However, due to factors such as their work experience, laboratory size, funding investment, and achievement transformation, the teachers' teaching and scientific research contents of colleges and universities seriously lag behind the development of the biopharmaceutical industry in reality.

Although basic research is the source of pharmaceutical innovation, biopharmaceutical colleges and universities and research institutes, as the main bases of basic research, have not yet provided strong support for the development of China's biopharmaceutical industry, which is mainly reflected in the fact that cutting-edge research mainly focuses on follow-up research, and the proportion of high-quality and pioneering research is low. The report *Construction of Chinese Medical Innovation Ecosystem (2021-2025)* released in 2021 shows that the number of papers published in the biopharmaceutical field in China in 2020 reaches nearly 290,000, but the papers published in the top three academic journals of *Nature*, *Science* and *Cell* only account for 0.17%, far lower than the leading countries in Europe and America (0.6%). In terms of achievement conversion, *2020 China Patent Survey Report* shows that among the 737 surveyed colleges and universities, the implementation rate of effective invention patents is only 14.7%, which is lower than the patent conversion rate of about 37% in high-level universities in the United States. In addition, domestic biopharmaceutical colleges and universities have not yet established a cross disciplinary and composite biopharmaceutical talent cultivation system with clear technical requirements and demands for drug research and development synthesis, research and development and production of biological products such as antibodies/proteins, research and development and production of drug formulations and cell therapy drugs, research and development and production of vaccine, development and optimization of biopharmaceutical production processes[2]. The above problems restrict the progressiveness and integration of teaching and research contents of related disciplines, and directly affect the level and effect of cultivation of application and innovation ability of biopharmaceutical talents.

2.3. Lack of high-level comprehensive ability training in teaching activities

At present, undergraduate teaching in biopharmaceutical major still relies on textbooks and focuses on teaching basic knowledge in various disciplines. However, there are few teaching activities related to the cultivation of problem-discovering, problem-analyzing, and problem-solving abilities, making it difficult to achieve the goal of cultivating innovative and applied talents with strong output abilities. The main reasons for this dilemma include: ① In terms of students, the basic professional knowledge is not solid enough, making it difficult to produce the biological knowledge learned, resulting in teachers being unable to carry out higher-level comprehensive ability training. ② In terms of teachers, although teachers in biopharmaceutical class colleges and universities have high academic qualifications, they generally lack practical working experience. The stage of basic research and

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applied research carried out by teachers of colleges and universities is very different, so no matter what type of teaching it is, it has not been combined with the practical application in a dynamic development. In addition, the single teaching method of teachers in the classroom, lack of reflection, and the unconditional implementation of targeted personalized teaching activities in large class teaching are also the reasons for the failure to train the students' deep comprehensive abilities. ③ In terms of school equipment configuration, biopharmaceutical has strong practicality, and its disciplinary feature is the combination of theory and experiment. This requires biopharmaceutical students to not only have strong theoretical learning abilities, but also have standardized and proficient experimental operation output abilities to solve problems in the development and production process of biopharmaceutical products. However, the requirements for instruments, equipment, funding, and venues in biopharmaceutical experiments and practical teaching are high, and most colleges and universities are unable to meet the corresponding requirements, which is also an important factor that restricts the achievement of high-quality learning output in biopharmaceutical experiments and practical teaching.

3. Reform exploration of OBE in the cultivation of biopharmaceutical talents

The educational concept of outcomes-based education (OBE) was first proposed by American scholar Spady in his book *Outcome-based Education: Critical Issues and Answers* [3,4], defining it as" a method clearly focusing on the education system and ensuring that students have the means to achieve success in future learning and work ". Chinese scholar Jiang Bo conducted a systematic study on OBE and proposed the "two purposes, four principles" of OBE education philosophy [5]. The two objectives are to ensure that all students have the knowledge, abilities, and quality necessary for success when leaving the education system, as well as to structure and control the school to achieve those results for all students. The four principles are: The first is to clearly focus on the final meaningful outcome. The second is to successfully expand opportunities and provide support. The third is to place high expectations on success. The fourth is to reverse design from the final result. Jiang Bo has also pointed out that OBE has flexibility, and each school needs to independently design and execute the major to meet their own industry needs as the core. Therefore, education based on learning outcomes can be considered as a learning output driven curriculum activity and Assessment system [6].

At present, the application of OBE education concept in the cultivation of biopharmaceutical class talents is mostly limited to the specific teaching design of a few individual professional courses [7-8], and its application in the construction of talent cultivation system is only seen in the preliminary exploration of the new model of "biopharmaceutical" education talent cultivation by Zhao Tiantian and et al. [9]. The core content of this study is to find out how to expand the scope of a course to design a cultivation model for biopharmaceutical talents at the professional cultivation level.

3.1. OBE oriented cultivation model design framework for cultivating biopharmaceutical talents

Table 1: Ability composition of undergraduate talents in biopharmaceutical major

Graduate quality	Specific requirements
1. Strong basic knowledge in biology and medicine disciplines	Master the necessary basic theoretical disciplines such as cell biology, immunology, molecular biology, biochemistry, genetics, genetic engineering, fermentation engineering, cell engineering, and achieve good academic results
2. Proficient skills in biological experimental operation	Be proficient in IHC, WB, cell culture, animal experiments, molecular manipulation, gene localization, instrumental analysis, DNA/RNA/protein detection technology, fermentation/separation engineering, protein separation and purification technology, ImageJ, SPSS analysis data software and other operations
3. Ability to comprehensively apply basic theory and experimental operation skills and knowledge to solve problems	Ability to apply theoretical and practical knowledge to analyze and solve problems in experiments, combining 1 and 2
4. Practical application ability in key fields of biopharmaceutical research and industry	Have the ability to understand the dynamic biological industry and be able to expand the laboratory scale to industrial output based on basic experimental principles, and being able to independently optimize industrial production
5. Independent learning and lifelong learning ability.	Be able to access, review, and assess relevant literature, closely follow the forefront of modern biopharmaceutical research, and carry out corresponding expansion learning

Based on modern life science, combined with genetic engineering, cell engineering, Enzyme

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engineering and other means, biopharmaceutical is the general name of drugs that can be extracted from organisms, tissues and body fluids to prevent, treat and diagnose diseases [10]. The qualities that undergraduate talent in biopharmaceutical major should possess upon graduation include: Master the basic knowledge of biopharmaceutical, be proficient in experiment and familiar with the application of various important biotechnology, have the ability to apply relevant knowledge and skills to discover problems in the field of biopharmaceutical, analyze and solve problems, and have the ability to track and grasp new research progress and development trends in the field of biopharmaceutical, and form correct life values and lifelong learning abilities (Table 1).

Based on a certain understanding of learning outcomes and the quality of graduates in biopharmaceutical major, combined with the OBE concept, it obviously emphasizes more on driving the operation and improvement of the entire system from the outcome output. Therefore, the elasticity of OBE can be started from the quality of graduates and integrated with the undergraduate cultivation of cultivation to design corresponding training systems (Figure 3).

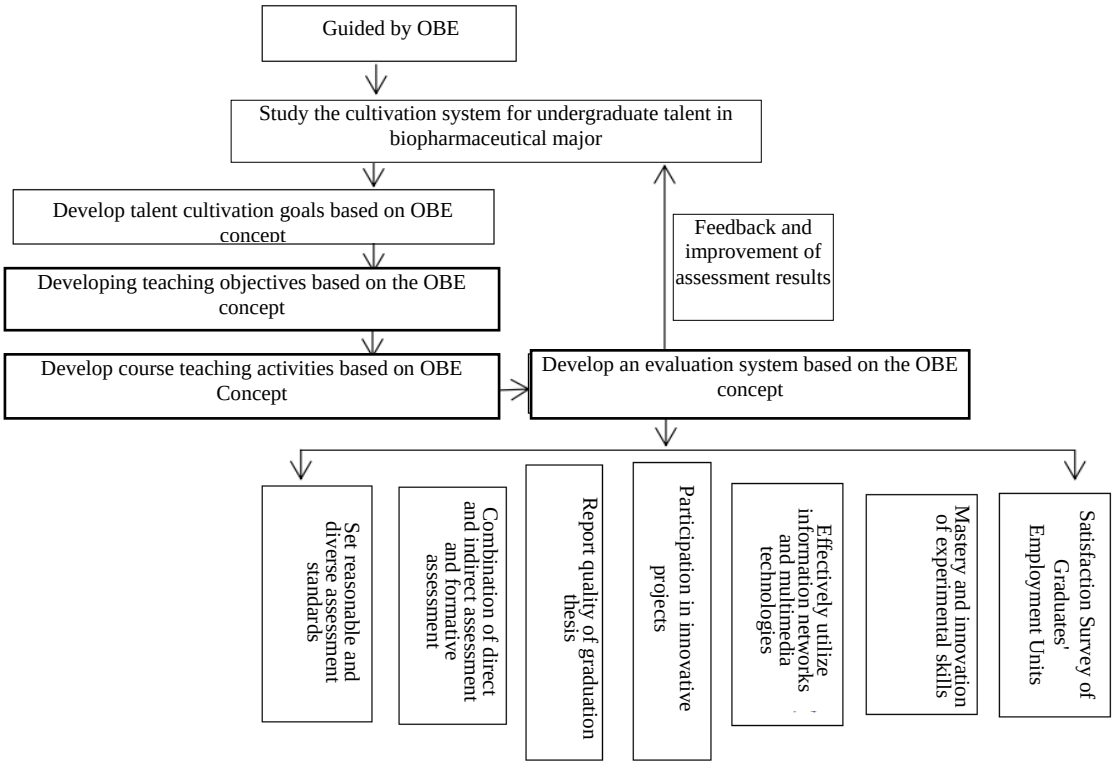

Figure 3: OBE oriented research framework for cultivating biopharmaceutical talents

3.2. Design of teaching activities for cultivating biopharmaceutical talents based on OBE orientation

In terms of curriculum design, it is necessary to fully consider student factors, with an emphasis on the students. Avoid experts dominating everything and ignoring direct and indirect experiences that connect students, resulting in dull and lacking overall system of course content. Developers should be familiar with the overall architecture of the course, and then fill corresponding knowledge into the architecture, and pay attention to the systematic design of basic theories. As one of the most dynamic fields, the biopharmaceutical related interdisciplinary integration includes the integration of knowledge between life sciences, as well as the interdisciplinary integration of biology and physics, biology and computer science, biology and chemistry, biology and mathematics, biology and informatics. Interdiscipline has expanded the theory and scope of various disciplines, making it easier for students to divergent their thinking, learn interdisciplinary applications, and cultivate comprehensive abilities in various aspects when learning it. Therefore, it is necessary to set up interdisciplinary courses. In terms of curriculum development, it is also necessary to follow the latest development in the field of biopharmaceutical at all times to let students participate in learning and research in the cutting-edge field of biopharmaceutical, and offer relevant courses based on the production needs of national and regional biopharmaceutical enterprises, hold regular lectures, etc.

In terms of the way to carry out teaching activities, teachers are required to have the ability to

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continue learning, regularly carry out continuing practical and applied education related to their respective majors, and actively engage in deep cooperation with leading units in the biopharmaceutical industry through various platforms and resources. Only teachers with abundant relevant knowledge and rich application experience can effectively guide students to follow up on the cutting-edge developments in biopharmaceutical research and industry. Teachers who study in biopharmaceutical related production enterprises and institutions can learn about the latest development status of enterprises, the latest cutting-edge knowledge, and policies for biological products. Most importantly, they can understand the dynamic requirements of biological enterprises for talents, and can convey the latest information about biological enterprises to students during teaching. In addition, teachers can adjust the teaching content and methods timely according to the development needs of the industry, to make the cultivated biopharmaceutical students more in line with the industry's requirements. Strengthen practical teaching. Firstly, it is necessary to increase the proportion of practical courses and increase practical ability training in both theoretical and experimental teaching. Secondly, schools should strengthen cooperation with enterprises, strive for more practical opportunities for students, and regard extracurricular practical learning of students as the norm. Practical teaching contents can be enriched through various forms of activities, such as organizing experimental and innovative competitions, attempting to carry out characteristic small class teaching, and enhancing the implementation of industry-university-research cooperation. Resources not only include the configuration of laboratories and funding for experimental materials, but also include the recruitment of experienced enterprise teachers to form a strong teaching team.

3.3. Strategies for OBE model based designing teaching assessment

The comprehensive assessment system combining multiple assessment is more conducive to providing reference suggestions for teaching feedback. It is possible to combine direct assessment of exams with indirect evaluation methods such as questionnaire surveys and in-depth interviews. It is necessary to pay more attention to formative assessment, so that teachers and students can provide timely feedback, thereby better improving teaching and learning, and promoting the development of teachers and students. Formative assessment includes: Regular classroom discussions, team assignments, open after-school exercises, presentations, etc. Set reasonable and diverse examination standards, and estimate the examination proportion, final paper exam proportion, and practicing examination proportion of each course based on the assessment observation points and score weights set for each course during the examination [11]. Collaborative teaching methods can also be set up, such as group discussions, allowing students to give play to their strengths and cultivate teamwork and cooperation spirit. Effectively utilize information networks and multimedia technologies as assessment tools, design various homework formats by Apps such as MOOC, Chaoxing, and Zhihuishu, allowing teachers to use these platforms to publish test questions, courseware, and upload course recorded videos. For some students who tend to self-study, whether they are learning at a fast pace or a slow pace, they can choose according to their actual situation, which is consistent with the OBE concept. Attach importance to the satisfaction survey of graduate talent employment units, and adopt the satisfaction survey of talent employment units, which can reflect whether biopharmaceutical talents meet the needs of employment unit, so as to provide feedback on teaching effect and guide teaching reform and progress.

4. Conclusions

OBE is an educational philosophy based on learning outcomes or oriented to results, with flexible characteristics of being able to adopt different approaches and methods according to different schools and regions when pursuing critical goals. OBE concept is introduced to establish a new model for cultivating biopharmaceutical talents, which will make the course objectives more precise and executable, the course implementation more operable, the course teaching assessment more objective and instructive, and provide ideas for building a flexible and sustainable high-level biopharmaceutical talent cultivation. For the effectiveness of integrating the OBE concept into the cultivation of biopharmaceutical talents, it is still needed to conduct further evaluation and feedback in future applications.

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