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Research and Practice on Promoting Students' Experimental Skills through Subject Competitions

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Abstract: Subject competitions play a significant role in enhancing the experimental skills of pharmacy students. This study, by analyzing the organization and implementation of the competition, found that it can stimulate students' interest in learning, promote active exploration, cultivate innovative thinking, teamwork and problem-solving abilities, and drive the optimization of teaching resources and the improvement of teaching methods. However, there are problems such as uneven resource allocation and differences in participation. Improvement measures are proposed to address these issues in order to better leverage the role of competitions in the cultivation of experimental skills.

Keywords: Subject competitions; Pharmaceutical Experiment teaching; Improvement of experimental skills; Innovative thinking; Teamwork

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1. Introduction

Experimental teaching of pharmacy in universities is of vital importance for cultivating students' practical and innovative abilities. The traditional teaching mode is teacher-centered, and students lack opportunities for active practice. Subject competitions provide students with a platform for independent design, operation and analysis, promoting the integration of theory and practice, enhancing experimental skills, innovative thinking and teamwork ability. It is of great significance to study their promoting role.

2. The Importance of Subject Competitions in Pharmaceutical Experiment Teaching

2.1. Stimulate students' interest in learning

Traditional pharmaceutical experiment teaching is prone to make students feel bored, while subject competitions, which are both interesting and challenging, can effectively stimulate their interest in learning. The competition questions closely follow the cutting-edge of pharmacy and practical applications, such as designing and synthesizing active pharmaceutical ingredients (API) in drug innovation experiments, guiding students to actively explore and experience the joy of experiments. Rich reward mechanisms such as bonuses and certificates further enhance the enthusiasm for participation,

helping students gain a sense of achievement and confidence when they achieve results, and strengthening their love for pharmaceutical experiments[1].

2.2. Promote the integration and application of knowledge

Pharmaceutical experiments integrate knowledge from multiple disciplines such as organic chemistry, analytical chemistry, and pharmacology. Subject competitions require students to comprehensively apply this knowledge to solve practical problems and promote interdisciplinary integration. In drug quality control competitions, it is necessary to combine analytical chemistry to detect components and use pharmacology to evaluate the effectiveness and safety of drugs. The competition questions have practical application backgrounds, which are conducive to deepening knowledge understanding and enhancing practical abilities. The simulated new drug research and development competition covers various links from design, synthesis, screening to quality control, closely following the real research and development process. It enhances students' grasp of complex processes and better adapts to the demands of future careers.

2.3. Cultivate students' innovative ability

Subject competitions encourage students to be bold in innovation and come up with unique experimental plans and ideas. In the competition, there are no fixed standard answers. Students can fully exert their imagination and creativity. This relaxed innovative environment can stimulate students' innovative thinking and cultivate their innovative ability.

For instance, in drug dosage form design competitions, students can attempt to apply new materials and technologies to design novel drug dosage forms. Some students may propose applying nanotechnology to the design of drug carriers to enhance the targeting and bioavailability of drugs. This innovative idea is hard to be fully developed in traditional experimental teaching, but in subject competitions, students have the opportunity to put it into practice.

Subject competitions will also invite experts to review and guide students' works. The rich experience and cutting-edge knowledge of experts can provide students with valuable suggestions and inspirations, help them further refine their innovative plans. Through communication and learning with experts, students can broaden their horizons and enhance their innovation level.

3. The specific role of subject competitions in enhancing students' experimental skills

3.1. Improvement of experimental operation skills

In subject competitions, students need to carry out a large number of experimental operations. In order to achieve good results in the competition, students must be proficient in the usage methods of various experimental instruments and experimental operation skills. For instance, in drug synthesis competitions, students need to use various organic synthesis instruments, such as rotary evaporators, vacuum pumps, reactors, etc. Through repeated operation practice, students can master the operation essentials of these instruments more proficiently, improving the accuracy and standardization of experimental operations[2].

Moreover, the experimental environment of subject competitions is often closer to the actual working scenarios, and the requirements for students' experimental operations are higher. Students need to complete the experimental tasks within the prescribed time, which requires them to have efficient experimental operation skills. Through continuous competition practices, students' experimental operation speed and efficiency will be significantly improved.

Experimental operation mistakes during the competition may lead to the failure of the entire experiment, which prompts students to develop a rigorous experimental attitude. Before the operation, students will check the experimental instruments and reagents more carefully. During the operation, they will strictly follow the experimental steps, thereby reducing experimental errors and improving the reliability of the experimental results.

3.2. Enhancement of experimental design capabilities

Subject competitions require students to independently design experimental plans. During the design process, students

need to comprehensively consider multiple factors such as the experimental purpose, principle, method and conditions. This requires students to have solid theoretical knowledge and strong logical thinking ability[3].

For instance, in drug screening competitions, students need to design reasonable screening models and experimental procedures based on the mechanism of action and screening objectives of the drugs. Students need to refer to a large amount of literature, understand the research progress in related fields, and combine their own experimental conditions to formulate scientific and feasible experimental plans. Through such training, students' ability to design experiments will be continuously enhanced.

In the competition, students also need to evaluate and optimize the experimental plans designed by themselves. They need to take into account factors such as the feasibility, economy and safety of the experiment, and constantly adjust the experimental plan to enhance the success rate and efficiency of the experiment. This ability to evaluate and optimize experimental plans is also an important component of experimental design capabilities.

3.3. Improvement of data analysis and processing capabilities

After the experiment, students need to analyze and process the experimental data. Experimental data in subject competitions are often rather complex and require students to analyze them using statistical methods and professional software. By participating in competitions, students can learn and master more data analysis methods and skills.

For instance, in a drug efficacy evaluation competition, students need to conduct statistical analysis on various physiological index data of experimental animals to assess the efficacy of the drugs. Students need to use statistical software such as SPSS to process data, draw charts and analyze the relationships between data. During this process, students can enhance their data analysis and interpretation skills.

Moreover, subject competitions also require students to draw scientific conclusions based on the results of data analysis and write experimental reports. This requires students to have good written expression skills and logical reasoning abilities. When students are writing experimental reports, they can clearly present their experimental processes and results, thereby enhancing their comprehensive qualities.

4. Practical Strategies for Promoting Students' Experimental Skills through Subject Competitions

4.1. Optimize the design of competition questions

The design of competition questions is the key to the success of subject competitions. The title should be closely integrated with the goals and requirements of pharmaceutical experiment teaching, and at the same time possess a certain degree of innovation and challenge. When designing competition topics, it is necessary to fully consider the actual level and ability of students to ensure that the majority of students can participate.

For instance, some competition questions related to drug research and development, drug quality control, drug analysis, etc. can be designed. These questions not only cover the key contents of pharmaceutical experiment teaching, but also reflect the cutting-edge issues in the field of pharmacy. The questions can be set at different difficulty levels to meet the needs of students of different skill levels. For students with a solid foundation, some innovative and exploratory questions can be set to encourage them to conduct in-depth research. For students with a relatively weak foundation, some basic questions can be set to help them consolidate the knowledge they have learned.

The competition questions should also have practical application value. By solving practical problems, students can better apply the knowledge they have learned to practice, improve their experimental skills and the ability to solve practical problems[4].

4.2. Strengthen teachers' guidance

Teachers play an important guiding role in subject competitions. Teachers should possess rich professional knowledge and

practical experience, and be capable of providing students with accurate guidance and suggestions. During the preparation stage of the competition, teachers can assist students in choosing appropriate competition topics, guide them to consult literature and design experimental plans.

During the experiment, teachers should promptly identify the problems existing in students and provide correct guidance. For instance, when students make mistakes in experimental operations, teachers should correct them promptly and explain the correct operation methods. When students encounter difficulties in experimental design, teachers should guide them to think and help them find solutions to the problems.

Teachers should also encourage students to be innovative and cultivate their ability to think independently. Teachers can organize students to have discussions and exchanges, share their experiences and ideas with each other, and create a good competitive atmosphere[5].

4.3. Improve the organization and management of competitions

Good organization and management of competitions are the guarantee for the smooth development of subject competitions. Schools should establish a dedicated competition organizing committee to be responsible for the planning, organization and implementation of the competition. The competition organizing committee should formulate detailed competition rules and scoring criteria to ensure the fairness, impartiality and transparency of the competition.

During the competition, time and venue should be reasonably arranged to provide students with good experimental conditions. It is necessary to strengthen the supervision and management of the competition process to prevent cheating and other violations. Schools should also establish a sound reward mechanism to honor and reward students and teams that perform outstandingly in competitions, thereby stimulating students' enthusiasm for participation.

5. Problems Existing in the Process of Promoting Students' Experimental Skills through subject Competitions

5.1. The distribution of competition resources is uneven

In subject competitions, there is often an uneven distribution of competition resources. Some key universities or laboratories have obvious advantages in the competition due to their abundant teaching resources and scientific research equipment. However, some students from ordinary colleges or laboratories may be unable to fully demonstrate their abilities due to the lack of necessary experimental equipment and materials[6].

For instance, in some competitions that require the use of high-end instruments and equipment, only a few institutions can provide such devices, and most students can only look on helplessly. This uneven distribution of resources will affect the fairness of the competition and also restrict the improvement of experimental skills of some students.

5.2. There is a significant difference in student participation

Although subject competitions can attract the participation of some students, there is still a considerable number of students who lack enthusiasm for them. These students may think that the competition is too difficult and they do not have the ability to participate. Or they think that the competition will take up a lot of time and energy, and affect their normal study.

There are also differences in the participation of students from different majors and grades. Generally speaking, senior students and those who perform well in core courses of the pharmacy major have a higher level of participation, while junior students and non-pharmacy major students have a lower level of participation. This disparity in student participation will lead to an insufficiently wide coverage of subject competitions, failing to fully leverage their role in enhancing students' experimental skills.

5.3. The integration of competitions and teaching is not close enough

At present, the integration of some subject competitions with pharmaceutical experimental teaching is not close enough.

The connection between the competition content and the teaching syllabus is not smooth enough. The knowledge and skills that students have learned in the competition cannot be well applied to their daily experimental teaching. Teachers also failed to make full use of competition resources during the teaching process to improve teaching methods and content, resulting in a disconnection between competitions and teaching[7].

6. Countermeasures to Address the Issue of Enhancing Students' Experimental Skills through Subject Competitions

6.1. Balance competition resources

To address the issue of uneven distribution of competition resources, schools and education departments should increase their investment in competition resources. A shared experimental platform can be established to share some high-end experimental equipment and materials, allowing more students to have the opportunity to use these resources. Experts can be organized to provide technical guidance and support to ordinary colleges and laboratories, enhancing their experimental teaching levels and competitive capabilities.

Competition funds can also be raised through corporate sponsorship, social donations and other means to provide students with more competition opportunities and resources[8].

6.2. Enhance student participation

To enhance students' participation, schools can take various measures. It is necessary to enhance the publicity and promotion of subject competitions to enable more students to understand the significance and value of the competitions. The rules, procedures and reward situations of the competition can be introduced to students through holding competition promotion meetings, distributing promotional materials and other means.

To lower the threshold for competitions, some competition events suitable for students of different levels should be set up. For students with a relatively weak foundation, some entry-level competition activities can be organized to enable them to gradually improve their experimental skills and confidence through participation. An incentive mechanism should be established to offer certain credit rewards or bonus points in comprehensive quality evaluations to students participating in competitions, thereby stimulating their enthusiasm for participation[9].

6.3. Strengthen the integration of competitions and teaching

To enhance the integration of competitions and teaching, teachers should incorporate competition content into their teaching plans. Some competition cases can be introduced into experimental teaching to enable students to understand the requirements and methods of competitions. Teachers can adjust their teaching content and methods based on the knowledge points and skill requirements of the competition to enhance the pertinence and effectiveness of their teaching.

Schools can also organize teachers to participate in competition training, enabling them to understand the latest developments and trends of competitions and enhance their ability to guide students in competitions. Through the guidance of teachers, the cultivation of innovative thinking and practical abilities in competitions is integrated into daily teaching, achieving an organic combination of competitions and teaching[10].

7. Conclusion

Subject competitions can stimulate the learning interest of pharmacy students, enhance their experimental skills and innovation capabilities. However, there are problems such as uneven resource distribution, low participation, and disconnection from teaching. The design of competition questions should be optimized, teachers' guidance strengthened, organizational management improved, and the integration of competitions and teaching promoted. In the future, it is necessary to innovate the forms of competitions, deepen the cooperation between schools and enterprises, provide more

practical opportunities, and promote the high-quality development of pharmaceutical experimental teaching.

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