

**Report**

Research on Three-Dimensional Teaching Reform Based on Ability Improvement Example of Pharmaceutical Analysis

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Abstract: The pharmaceutical analysis course is an important bridge to train students' competence in evaluating drug quality. The members of the research group combined the position requirements of quality control (QC) in pharmaceutical factory with many years of teaching experience, and wrote the pharmaceutical analysis experiment handout and PBL teaching case in line with the development of The Times. This paper analyzes the relationship between the key words in PBL case and the knowledge of the pharmaceutical analysis course, expounds the implementation process of PBL teaching and its significance, and briefly introduces the rain classroom and virtual simulation experiment platform used in teaching. Over the years, the teaching mode of combining rain classroom, PBL and virtual simulation experiment has gradually become the feature of the course of pharmaceutical analysis in our school. This paper discusses the three-dimensional teaching reform of rain classroom, PBL and virtual simulation experiment, and analyzes the teaching effect of the teaching reform with a questionnaire survey. The change of students' learning ability is analyzed from the aspects of student achievement, student self-evaluation and mutual evaluation and classroom evaluation, and it is found that the teaching mode can improve students' self-learning ability, critical thinking innovation ability, and cooperation and communication ability to a certain extent.

Keywords: The Rain Classroom, PBL, Virtual Experiment, Pharmaceutical Analysis Courses, Ability

1. Introduction

Pharmacy is a subject with strong practicality and application. One of the important tasks of the pharmaceutical analysis course is to develop quality standards for pharmaceutical products [1-3]. The pharmaceutical analysis course is an important bridge to train students to evaluate the competence of drug quality post. Pharmaceutical analysis has applications in the fields of "drug development", "drug manufacturing" and "drug use", Control the safety, efficacy and quality of drugs by analyzing their active ingredients. The content of "drug quality assessment" in the textbook is broad and has the characteristics of strong comprehensiveness and some obscure theories. It is difficult for students to understand and master the teaching according to the traditional teaching method of "Cramming Education" [4]. The members of this research group used PBL [5] case

teaching to integrate the core issues of drug quality standard formulation into specific cases, taking the case as the line, and hiding various knowledge points in the cases. Students learned by analyzing PBL cases, so as to achieve the purpose of grasping the core issues from point to aspect. In addition, we adopted blended online and offline teaching, and applied flipped classroom, PBL teaching and virtual simulation experiment to the teaching of Pharmaceutical Analysis course in our school, which improved students' ability to analyze and solve problems [5-7], and improved students' expression ability and humanistic quality. In this paper, we summarized and analyzed the implementation process and effect of the above teaching methods in this course, and found that the reform has achieved good teaching effects in many years of practice.

2. Reform Background

Present and numerous information portal and access to knowledge, if we still as stated earlier, in accordance with Cramming Education [2-4] the method of teaching of pharmaceutical analysis theory and experiment, the teaching effect obviously is not too good, this model not only unfavorable to stimulate students learning enthusiasm and subjective initiative, but may let the students to rely on the teacher. Students are used to listening to the teacher in class to explain the problem, after class will not take the initiative to solve the problem, just want to ask the teacher for help.

Pharmaceutical analysis experiments include many testing technologies, among which high performance liquid chromatography (HPLC) is increasingly widely used in drug testing [8]. As a large precision instrument, it requires the operator to have profound theoretical knowledge and practical experience. In the past, teaching experiments only stayed at the level of demonstration or verification. Students only carried out experiments according to the experimental handouts, and did not have to or would not take the initiative to use classroom knowledge to complete the experiments. The "spoon-feeding" method of teaching, most students are passively accept, rarely can exert students' subjective initiative and innovative thinking, caused the student's perceptions of the experiment is not deep, to the operation of the equipment operation principle, the instrument use not familiar with, there is not enough research into the problem, unable to stimulate the enthusiasm of students for experimental courses and the interest in learning.

Undertake to the student learning analysis found that the early stage of the students learned basic courses and professional basic course for pharmacy, two and a half years of knowledge reserves basically met the basic condition of pharmaceutical analysis course, but most of the students are lazy, used to listen to the teacher teaching, basic don't take the time to review after class, the more no search related literature material in-depth study, test according to the examination site to review a thing or two, After the test, they throw it away. This way of learning students learning enthusiasm is not high, cannot achieve a good learning effect.

This team member in pharmaceutical analysis course teaching pays attention to the use of information technology means, in turn rain class mode is adopted to improve the classroom teaching, in view of the difficult point content writing pharmaceutical analysis both PBL teaching cases, the student-centered learning mode, can stimulate the student interest, induce thinking, make the student is in a state of

active learning, Develop students' comprehensive ability to solve complex problems and higher-order thinking.

3. Reform Practices

3.1. Prepare Lecture Notes for Drug Analysis Experiments

At present, liquid chromatography has been popularized in various enterprises and drug testing departments, and its use is increasingly extensive. We closely follow the requirements of The Times, pay attention to the competency of quality control (QC) positions in pharmaceutical factories, recombine and optimize the Pharmaceutical analysis experiment handouts, and focus on training students' basic skills of correctly using large instruments. Two liquid chromatography experiments and two gas chromatography experiments are added to the new handout. More than 60% of the total numbers of chromatographic tests were conducted. At the same time, the virtual simulation experimental platform training and assessment were included in the new experimental handout, so as to cultivate competent drug testing talents and form drug analysis experimental handout that conforms to the development needs of The Times.

3.2. Compile PBL Teaching Case

The PBL teaching case [9-11] written by members of this group, for example, combine drug quality standard research workers of the practical work, predetermined drug researcher challenge in the work, its environment and conditions, let the students put themselves in put forward questions and try to solve the problem, Table 1 shows the key words in the PBL case corresponding to the key issues in "setting drug quality standards". From table 1, according to the PBL implementation process, guide students to the key problems in keywords in PBL case study analysis, access to a variety of data, can be to "develop drug quality standard" this content have a deeper knowledge and understanding. This is also the beauty of PBL teaching, allowing students to dig problems in their own shoes, identify key issues, and work together in multi-person teams to complete learning projects in an orderly setting. Compared with the traditional teaching in which the teacher alone teaches a large group of students face-to-face, PBL teaching promotes students' learning enthusiasm, gives full play to students' learning initiative to a large extent, and expands the depth and breadth of knowledge points for students after class.

Table 1. The key words in the PBL case correspond to the key issues in "setting drug quality standards".

Key words in the case	Keywords correspond to key questions (knowledge)
Drug quality control	What are the guiding principles for the study of drug quality standards? What are the main contents of quality standards? What is the purpose and content of drug quality and stability research? What specific information can be provided for reference?
Quality standards for generic drugs	What is a generic drug? What do generic drug quality standards include? What is consistency evaluation of generic drugs?
Establish-quality standards for API and preparations	What are the similarities and differences between quality standards for API and preparations? What does the formulation and drafting of drug quality standards include? What are the principles to follow?
Content-determination item	What are the methods for determination of drug content? How to choose the method for determination of drug content? What are the principles to follow?

Key words in the case	Keywords correspond to key questions (knowledge)
Drug structure formula	What is the relationship between drug structure and the choice of content determination method? What are the properties of the drug embodied in the formula? What properties can be used as the basis for content determination?
Dissolution behavior	What is the relationship between the preparation of the sample and its dissolution behavior?
Prescription drug	What information does the prescription give? Does the excipient interfere with the selected assay? If there is interference, how to eliminate it?
measurement principle	What is the principle of the content determination scheme? On what basis?
Specific steps	What is the basis for each specific step? How to determine the sample size? Is each step standardized and rigorous?
A formula to calculate	What does each letter represent in the formula for the various content determination methods?

*The example for this table.

As can be seen from Table 1, this case guides students to find problems from more than ten entry points according to the requirements of the course outline and the relevant theories given in the textbook. Through the training of PBL course, students can get the understanding and application of knowledge points by analyzing cases, and enhance the ability to solve practical problems.

3.3. Rain Classroom, PBL and Virtual Simulation Experiment Combined Teaching Model

Team members of pharmaceutical analysis course teaching reform, pharomic undergraduate class can be divided into traditional class and flip class, flip class theory class uses the rain small programs, give students push Micro-lecture before class, students based on Micro-lecture and textbook content, and will learn classroom situation feedback to the rain small programs, according to the data provided by the rain classroom teaching teachers fully understand students' learning. Analyze the key and difficult points in the offline classroom. In the flipped class, teachers are no longer as full as the traditional class teaching, and students cannot only play the role of audience like the traditional class, but need to learn actively. [12, 13]

Flipped classroom is a blended online and offline teaching model, which not only encourages students to learn actively, but also enables teachers to grasp students' learning situation in time.

Teachers make full use of various functions of the rain classroom mini program. Teachers can push corresponding exercises and quizzes to students according to the key and difficult points of each chapter, and urge students to review in time. We carry out stage tests for students in time, which is helpful for students to master the knowledge points of the course and promote the orderly teaching. [14]

In addition to adopting rain classroom mini program for teaching, we also adopted PBL [5-7] teaching mode, and discussed in groups according to PBL cases prepared by the research group. Each group was assigned a tutor. The whole PBL teaching was divided into three acts. In the first and second acts, case materials were given to the group members, and the group members discussed according to the case materials. In PBL teaching, students consult literature materials, use professional knowledge to analyze cases, put forward problems and design specific solutions. This process

develops students' autonomous learning ability and stimulates students' initiative and enthusiasm to participate in learning. [15, 16]

Furthermore, in view of the high cost of large-scale instrument experiments, which will produce more experimental waste liquid, the members of the research group applied to purchase the virtual simulation experiment software from the department, and the practical training and assessment of the virtual simulation experiment platform were included in the handout of the new experiment. We first let the students use the laboratory liquid chromatography to test the samples, and then to the virtual simulation platform for learning and assessment. On the one hand, setting up virtual simulation experiment can let students get in touch with large instruments again and master the basic skills of using large instruments; on the other hand, it can reduce the number of classes of large instruments and achieve the effect of environmental protection and reducing expenditure.

4. Teaching Effect

For many years, the research in the pharmaceutical analysis course teaching in classroom, the Rain Classroom, PBL combined with a virtual simulation experiment of teaching mode, has obtained the good teaching feedback, we analyze the student grades, students' evaluation in PBL curriculum, students to turn classroom and virtual simulation platform of evaluation reform results of teaching practice, analyses the change of students learning ability, Detailed data are shown in Tables 2-5.

4.1. Students' Academic Performance Improved Significantly

We divided the pharmacy undergraduate class into traditional class and flipped class for teaching. There were 80 students in the traditional class as the control group. The flipped class was the experimental group, a total of 60 students; The comparison of final examination scores between the experimental group and the control group is shown in Table 2. The average score of the experimental group is ten points higher than that of the control group, and the scores of the comprehensive analysis questions between the two groups are quite different.

Table 2. Comparison of students' theoretical examination scores (score, $X \pm S$).

group	Comprehensive analysis question	Objective questions	Subjective questions	Total score
experimental group	21.3 \pm 4.27	23.5 \pm 3	29.4 \pm 4.2	74.1 \pm 7.75
control group	17.3 \pm 6.63	21.8 \pm 2.8	27.3 \pm 4.7	66.5 \pm 9.2
Value of T	-3.22	-2.71	-2.32	-4.35
Value of P	<0.05	<0.05	<0.05	<0.05

4.2. Self-Evaluation and Mutual Evaluation Results of Students' Various Abilities After PBL

Table 3. Student ability self-assessment peer assessment scale.

items	0points	2points	4points	6points
Critical thinking	poor	general	good	excellent
Team work ability	poor	general	good	excellent
Interaction and Communication	poor	general	good	excellent
Responsibility and respect	poor	general	good	excellent

Table 4. Comparison of self-evaluation and mutual evaluation scores of students' various abilities after carrying out PBL (score, $X \pm S$).

items	Critical thinking	Team work ability	Interaction and Communication	Responsibility and respect
Before PBL class	5.48 \pm 0.22	4.79 \pm 0.86	5.47 \pm 0.331	5.41 \pm 0.392
After PBL class	5.94 \pm 0.106	5.95 \pm 0.054	5.96 \pm 0.04	5.97 \pm 0.03
Value of T	-10.26	-8.05	-8.85	-8.47
Value of P	<0.05	<0.05	<0.05	<0.05

4.3. Students' Evaluation of Flipped Classroom and Virtual Simulation Platform

Table 5. Results of after-class questionnaire survey ($n=45$).

Evaluation content	approval	negate	unclear
Whether the flipped classroom stimulates learning interest	36	4	5
Does flipped classroom improve learning motivation	39	3	3
Whether it improves learning outcomes	38	5	2
Whether virtual simulation experiment is necessary	37	2	6
Whether it is helpful to master experimental skills	36	5	4

All analyses were performed using *Reversion* 3.5.1. According to the data in Tables 2-5, compared with the control group, the experimental group carrying out the teaching reform had higher test scores and improved various learning abilities, and the teaching reform was highly recognized among students. By analyzing the paper scores of the experimental group students in the past three years, it was found that the excellent rate of the students increased and the failure rate decreased. In addition, in the past three years, the postgraduate entrance examination rate of students has increased, and some students have participated in the research of pharmaceutical analysis research group and won a number of university and district-level awards.

5. Conclusion

The teaching model combining rain class, PBL and virtual simulation experiment encourages students to actively prepare before class, think carefully in class, discuss in groups, and make vivid images. Meanwhile, the PBL teaching cases of pharmaceutical analysis are written according to the key and difficult contents, which also enable students to better connect theoretical knowledge with production practice. Students' interest in learning has been significantly improved, which improves the situation of passive acceptance of knowledge and poor initiative of students. Students actively communicate in groups, which

lays a foundation for later graduation design, competition and work, and the dominant position of students is gradually strengthened [16]. It can be said that our curriculum reform over the years has achieved good teaching results.

From the perspective of emotion, attitude and values, students can not only further understand the difference between generic drugs and original drugs by consulting relevant materials of generic drugs, but also analyze the national conditions in a more objective and rational way, realize the significance of the country's encouragement of the research and development of generic drugs, and consider the problem from a professional and humanistic perspective. This is an inspiration to the students, is a lever to think the key.

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