

# The Construction and Application of Process Evaluation in the Grade Evaluation of Pharmacology Experiment

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## ABSTRACT

Pharmacology laboratory teaching includes basic animal handling, basic experiments, integrated experiments, designed experiments and scenario-based discussions between doctors and patients. The problems in the evaluation of pharmacology laboratory performance include the predominance of summative evaluation, a single index for laboratory performance assessment and weak teaching feedback. This paper aims to discuss the practice and significance of adding process evaluation to the evaluation system of pharmacology experiment teaching. Our university has initially established a process evaluation system, which has been fully applied in the pharmacology laboratory teaching of 896 students majoring in pharmacy, clinical pharmacy and traditional Chinese medicine. Process evaluation can not only deepen students' understanding and application of basic knowledge of pharmacology, but also stimulate students' innovative thinking and initiative and enthusiasm to participate in pharmacology experiments, laying the foundation for clinical drug use and new drug research, so as to build a new experimental teaching system and improve the quality of pharmacology experimental teaching.

**Keywords:** Grade Evaluation of Experiment, Pharmacology Experiment, Process Evaluation.

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**Received:** 28-01-2025;

**Revised:** 08-04-2025;

**Accepted:** 19-06-2025.

## INTRODUCTION

The professional disciplines of pharmacy and clinical pharmacy at our university have been awarded the titles of Applied Demonstration Major of our Province and Provincial Characteristic Major of Undergraduate Colleges and Universities in our Province, as well as the Pharmacy Major is a national first-class undergraduate major construction site. To comprehensively deepen the reform of the experimental teaching curriculum system of pharmacy and clinical pharmacy in our university and to strengthen the cultivation of students' innovative and entrepreneurial ability and scientific research thinking, the pharmacology experiment has gradually been separated from the traditional pharmacology teaching and medical functional medicine experiment to become a new independent experimental course. However, the traditional summative evaluation is clearly unsuitable for evaluating the performance of pharmacology experiments because of its single indicator. Our university

has initially constructed a process evaluation index for the performance of pharmacology experimental courses, which has been comprehensively applied to pharmacology experimental teaching in pharmacy, clinical pharmacy, clinical medicine and traditional Chinese medicine to promote the combination of theoretical and practical teaching of pharmacology and to comprehensively cultivate the students' operational ability, innovation and entrepreneurship and critical scientific research thinking. Many scholars have researched about the application of process evaluation in the teaching of pharmacology theory courses, functional science experiments and other courses such as experimental courses.<sup>1-3</sup> however, the study of process evaluation indexes for pharmacology experimental performance has not yet been reported. Scientific and effective evaluation of undergraduates' experimental performance through process evaluation can not only deepen students' understanding and application of the basic knowledge of pharmacology, but also stimulate students' innovative thinking and their initiative and enthusiasm to participate in pharmacology experiments, laying the foundation for future clinical use and new drug research, thus innovating the experimental teaching system and improving the quality of pharmacology experimental teaching.<sup>4,5</sup>



DOI: 10.5530/ijper.20257182

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## Major Problems in the Evaluation of Pharmacology Laboratory Performance

### Status of predominantly summative evaluation

At present, many domestic higher pharmaceutical colleges and universities pharmacology experiments are still mainly used in laboratory reports or laboratory operation examination-based summative assessment.<sup>6</sup> However, this traditional evaluation method obviously ignores the influence of process evaluation on experimental performance such as attitude, enthusiasm for participation, hands-on level, observation and analysis ability, innovative thinking and teamwork ability of pharmacy, clinical pharmacy, clinical medicine, Chinese medicine and other professional students in the process of pharmacology experiment. These influences lead to insufficient motivation and initiative of students to participate in pharmacology experiments, which is not conducive to the effective realisation of the training objectives of pharmacology experimental teaching.

### Single indicator for the evaluation of experimental performance

Pharmacology experimental teaching should achieve the following three goals: (1) Pharmacy, clinical pharmacy and other professional students to master the basic methods and skills of pharmacology experiments, to improve the operation ability and to gain knowledge of pharmacology experiments; (2) to validate certain important basic theories in the teaching of pharmacology and to deepen the understanding and mastery of the knowledge and basic concepts of pharmacology. (3) Training to cultivate students' hands-on operation, observation, comparison, analysis and innovative entrepreneurship and critical scientific research thinking, to develop a scientific attitude of seeking truth from facts and to cultivate the ability to solve practical problems by applying experimental knowledge of pharmacology.<sup>7</sup> However, the current evaluation index of pharmacology experimental performance only adopts students' experimental report as the basis of experimental performance evaluation and does not make detailed evaluation of various operational techniques in the experiment, such as: animal catching and fixation, drug delivery method, anaesthesia and execution, *in vitro* experiments, bio-signal acquisition system, prescription writing standard, case analysis and drug use and literature search and other indicators. Therefore, the traditional pharmacology experimental performance assessment index is single and it is difficult to accurately reflect the real experimental situation of undergraduates of various majors. Therefore, the traditional pharmacology experimental performance evaluation index is single and it is difficult to accurately reflect the real experimental situation of undergraduate students of various majors.

## Weak educational feedback

The traditional pharmacology experimental performance evaluation mainly uses summative evaluation.<sup>8</sup> Untimely feedback makes students only know the pharmacology laboratory performance at the end of the course. Students had to accept this passive evaluation, but the feedback information credit of the experimental results was seriously diluted, thus making it difficult to detect and correct the operational errors in the experimental process of students in pharmacy, clinical pharmacy, clinical medicine and Chinese medicine in a timely manner and at the same time failing to reflect the innovative thinking of the students.

## The Necessity of the Implementation of Process Evaluation

Process evaluation is a dynamic evaluation of the pharmacology laboratory teaching process, throughout the whole process of experimentation, is a streamlined, for an important point in the experiment to make an evaluation and all the points are converged into a line and constitute the overall evaluation.<sup>9,10</sup> Therefore, process evaluation is a stage-by-stage assessment of the experimental effect of pharmacology for students of pharmacy, clinical pharmacy, clinical medicine, Chinese medicine, etc. It is a comprehensive assessment of the whole process of experimentation and is an important part of the course assessment. Pharmacology experiment is a highly experimental subject, the participation in the course, the degree of operation norms and the completion of the quality of the laboratory report are important basis for the judgement of the mastery of knowledge and skills of students in pharmacology laboratory. According to the requirements of the Ministry of Education for the accreditation of pharmacy, clinical pharmacy, clinical medicine, Chinese medicine and other specialties, this experiment course is targeted to the selection of five major experimental modules: Basic handling of commonly used animals (basic experiment), Determination of plasma half-life of drugs (basic experiment), Effects of drugs on isolated intestinal muscle (designed experiment), Effects of cardiac glycosides on isolated frog heart (comprehensive experiment, isolated experiment), Case discussion of simulated medication regimen between doctor and patient (scenario-based teaching). The experiments are integrated (qualitative and quantitative experiments, *in vitro* and *ex vivo* experiments), with a clear focus and a balance between difficult and easy experimental projects. These experimental courses enable students to master the basic pharmacology experimental methods while also stimulating students' innovative thinking and improving their ability to use drugs rationally. In our current teaching practice we have found that undergraduate students in all disciplines are more active thinkers and prefer to ask questions. It is an urgent need to use process evaluation to instantly test the effect of pharmacology experiments, to provide real-time feedback on students' experimental information, to prompt students to quickly grasp

the key points and difficulties of experimental content, to cultivate students' innovative thinking and to make the process of each experimental module more effective and efficient.

### **The Construction of Process Evaluation In Pharmacology Experiments**

In the actual teaching exploration, we conducted a process evaluation of the pharmacology teaching laboratory course for a total of 896 students majoring in pharmacy, traditional Chinese medicine and clinical pharmacy to understand the effect of the process evaluation on the promotion of teaching and learning with the feedback from the students.

#### **Attendance and laboratory performance (10%)**

Attendance of students is an important means of establishing a normal teaching order and improving the quality of pharmacology laboratory teaching. Incorporating attendance into the process evaluation of pharmacology experiments can be an important measure to discipline students in pharmacy, clinical pharmacy, clinical medicine and Chinese medicine, as well as an essential component of the final evaluation grade. Attendance at Our university has evolved from the initial paper list check-in to online check-in on the CHAOXING App. in recent years. Fast and efficient online check-in keeps an accurate record of when students enter the lab and allows for fine-grained management of attendance. As for the laboratory performance, a few students who could not correct the experimental attitude were afraid to operate for fear of animals, did not operate in a standard way and did not record or analyse the data, which would seriously affect the results of the pharmacological experiments. In addition, some students did not participate in the whole experiment and the experimental report was perfunctory or plagiarised, which made the pharmacology experimental teaching not achieve the expected results. Therefore, we have made attendance and usual performance 10% of the final evaluation grade.

#### **Online pharmacology experiment videos (10%)**

Since 2022, we have launched the pharmacology experiment Wechat public account for undergraduates of all majors in the whole college, allowing students to familiarise themselves with the purpose, principles, key steps and precautions of operation of pharmacology experiments in advance through mobile phones to preview them and recording more than 20 videos (Figure 1), which has significantly improved the quality of pharmacology experimental teaching. Our undergraduate students participate in the pharmacology experiment project videos and familiarise themselves with the key steps of pharmacology experiments through WeChat, which lays a solid foundation for improving the success rate of pharmacology experiments. The online pharmacology experiment video study is accounted for 10% of the final assessment grade.

#### **Experiment report (40%)**

Pharmacology experiment reports are records, analyses and summaries of pharmacology experiments. Students learn to search for literature, organise and analyse the experimental results, discuss and draw experimental conclusions in combination with theoretical knowledge through writing pharmacology lab reports, which lays foundation for writing scientific research papers in the future. Experimental results should be a true and detailed record of the reactions and phenomena observed by the students in the pharmacology experiment. Depending on the purpose of the experiment, the results may be presented in the form of textual qualitative descriptions, data graphs or statistical charts. In addition, curve records should be collated, cut and pasted and accompanied by graphical notes and necessary textual descriptions. Discussion is an adequate interpretation and analysis of the results of this experiment based on basic knowledge of pharmacology. Conclusions are brief summaries of concepts or theories generalised from the results of pharmacological experiments and discussions. The experiment report should be concise, fluent, clearly written, neat and correctly punctuated. Pharmacology experiment reports must be completed independently by the student and should not be copied from others. Completion of pharmacology experiment report helps to deepen students' understanding and application of the basic pharmacology knowledge, cultivate students' hands-on ability of experimental operation, analytical ability of rational use of drugs and innovative thinking ability and lay the foundation for future clinical and new drug research. In addition, students experience the hardship of experimental research through the writing of pharmacology experiment reports and form the spirit of active exploration, the courage to forge ahead in the pursuit of knowledge and the pursuit of truth and good will quality. Pharmacology experiment reports account for 40% of the final assessment grade.

#### **Drug treatment programme case discussions (scenario-based teaching) (10%)**

Students simulate doctors and patients, analyse cases and make full use of their theoretical knowledge of pharmacology to develop appropriate drug administration protocols. This allows students to better understand and grasp the theoretical knowledge of pharmacology and clarify that learning pharmacology is the key to providing a theoretical basis for guiding the rational use of drugs in clinical practice.<sup>11</sup> Students are given paper-based typical clinical cases (chosen as needed) before class and we use Project-Based Learning method, discussion-based and scenario-based teaching formats. The teacher first instructs the students to simulate a doctor and a patient separately and exchange them during the lab session. Then the groups discuss and analyse the cases and draw up treatment plans. Finally, the teacher and the students analyse the treatment plans of each group and judge the correctness of the choice of drugs and the possible hazards. Drug treatment

programme case discussions (scenario-based teaching) account for 10% of the final assessment grade.

### Basic operation assessment of experimental animals (30%)

Pharmacology experiments require students to: (1) standardise the operation and accurately calculate the dosage of drugs given to each group of animals; (2) carefully observe the various reactions of animals in the course of the experiment and objectively record the time of reaction, performance and regression of the drugs; (3) think about theories in relation to practice; (4) master the method of catching and holding the animals, the commonly used methods of administration, the conversion of dosage and the observation and recording of major pharmacological, physiological or biochemical indexes; (5) master the common experimental methods such as the measurement of blood pressure and the commonly used experimental equipment

such as the syringes, the scales and the use of the software for the Bioinformatics Processing System and so on. Pharmacology experimental operation examination accounts for 30% of the final assessment grade, which helps to cultivate students' pharmacology experimental skills and innovative thinking and is an important basis for judging the mastery of students' pharmacology experimental knowledge and skills.

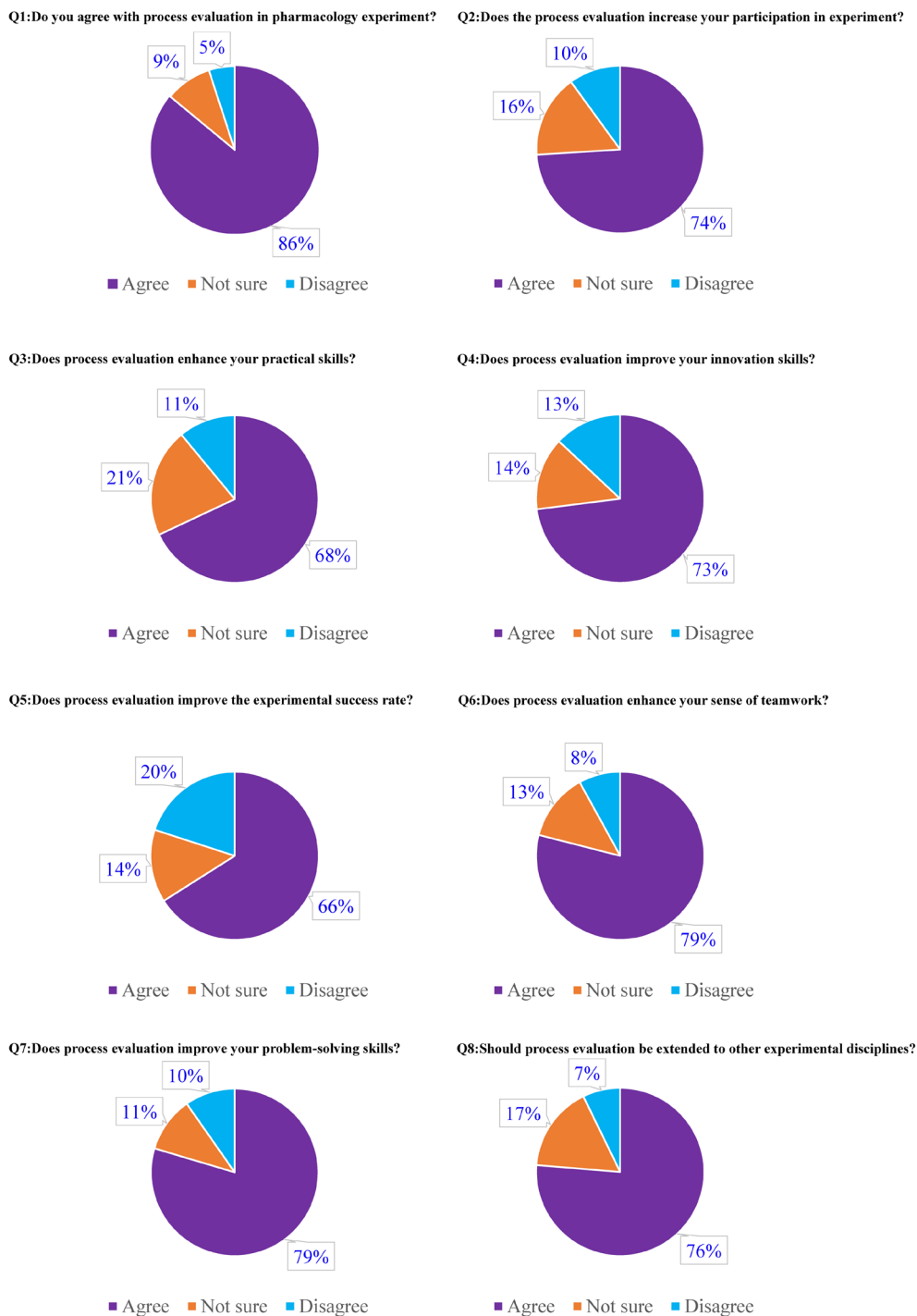
### Effectiveness of process evaluation

#### Student-centred teaching methods

The implementation of process evaluation of pharmacology teaching experiments for 896 students in pharmacy, clinical pharmacy, clinical medicine and traditional Chinese medicine has fully embodied the student-centred approach and increased the motivation of students to perform experiments.<sup>12</sup> Students take the initiative to watch online experiment videos and actively consult related information. During the pharmacology experiments,



**Figure 1:** Pharmacology experiments on WeChat public account and some of the recorded videos. (A) Experimental teaching video on plasma half-life determination of sodium salicylate. (B) Functional Science Experimental Skills Evaluation Video. (C) Physiological Signal Acquisition System Demonstration Education. (D) Demonstration of blood collection for rabbits.



**Figure 2:** Statistical analysis chart of the main questionnaire results.

members of each group divide the work, actively discuss, operate carefully and devote themselves to the experiments. As the success rate of the experiment is greatly improved, students will have a high sense of achievement, which greatly enhances their participation and motivation in pharmacology experiments. At the same time, the timely feedback of process evaluation helps students find the problems and deficiencies and promotes reflection and continuous improvement. Process evaluation has

been praised and supported by the vast majority of students at Our university and students of all majors generally believe that process evaluation better reflects the fairness and objectivity of pharmacology experimental evaluation and should be vigorously promoted in other experimental disciplines. After the process evaluation, we designed a questionnaire containing 25 questions in an anonymous form, with each question including three answers: "agree" (2 points), "not sure" (1 point), "against" (0

points), in order to find out the 896 students' comments on the process evaluation. The statistics of the main questionnaire are shown in Figure 2.

### **Timely feedback promotes teachers to adjust experimental teaching**

The construction of process assessment puts forward higher requirements for pharmacology experiment teachers of Our university, who need to carefully design pharmacology experiment contents and innovate teaching methods according to the learning situation and objectives of pharmacy, clinical pharmacy and other professional students. The focus of pharmacology laboratory teachers has also been transformed from the previous focus on teaching operational steps and grading laboratory reports to the design of experimental protocols, students' hands-on ability, pharmacology experimental problem-solving ability and the cultivation of students' comprehensive quality. At the same time, the timely feedback of the process evaluation allows teachers to understand the experimental mastery of the professional students as well as the weak points and adjust the experimental teaching in time to promote the reform of pharmacology experimental science.

### **Significantly higher student innovation and entrepreneurship capacity**

The process evaluation has been well received by students and experts, prompting students to enjoy laboratory animals, pharmacology experiments and become more and more interested in new drug research. In recent years, the number of students applying for "Innovative Entrepreneurial Projects for University Students" based on their experimental knowledge of pharmacology has been increasing year by year. By 2024, a total of 26 projects under the guidance of pharmacology teachers have been established, including 5 national projects.

## **DISCUSSION AND IMPLICATIONS**

Previous pharmacology experiment evaluations focused only on pharmacology professional knowledge and skills and there was a serious lack of evaluation in ideological and political indicators such as animal ethics education, life education and labour education.<sup>13,14</sup> As a result, some students in pharmacy, clinical pharmacy, clinical medicine, Chinese medicine and other professions have a series of problems such as indifference to the sense of teamwork, failure to carry out timely cleaning of the experimental bench and even rudely treating experimental animals. The construction and application of process evaluation in pharmacology experiments at Our university significantly increased the importance and responsibility of pharmacology laboratory teachers in evaluating undergraduate students' experimental performance. The process evaluation prompts teachers to transfer from focusing only on teaching pharmacology

experimental principles and steps to inspiring students' innovative scientific research thinking, checking students' usual performance in pharmacology experiments, attaching importance to the cultivation of students' experimental operation skills and the comprehensive ability of accurately recording and analysing the experimental results. In conclusion, the introduction of process evaluation mode in pharmacology experimental performance assessment, the experimental project design should be student-centred, the experimental process should be based on the main line of promoting students' development and the assessment index should be based on the premise of promoting students' ability to improve. Teachers should stimulate students' curiosity, guide students to change from passive acceptance to active investigation and cultivate students' hands-on ability, analytical and problem-solving ability and innovative thinking through pharmacology experiments.<sup>15</sup> In addition, the process evaluation can reflect the effect of pharmacology experiments and the need for improvement in teaching, which will improve the level and quality of pharmacology experimental teaching. However, there is still some room for improvement in the process evaluation that we have initially constructed. In the Attendance and laboratory performance section, both online and offline sign-in methods still have some students signing in for others, which needs to be improved. In the online pharmacology experiment videos part of the teaching, the lack of supervision of students' learning progress led to some students using other electronic devices for fake learning of the courseware "to hang up and refresh the progress of the teaching videos". Plagiarism is still unavoidable in the written part of the experiment report. In the part of scenario-based teaching, we are considering to gradually move the simulated scenarios to the real clinic in order to improve the teaching effect of pharmacology. As for the online software teaching mode, we are also considering to enhance the international level, so that the pharmacology teaching mode and process evaluation mode can go to the world. The science and reasonableness of the process evaluation needs to be further optimised and adjusted, especially by adding a Civics section to the course. The teaching of pharmacology experiment should be centred on the dual nature of drugs and value-oriented moral education in the whole process of teaching, learning and evaluation, to help students establish the scientific spirit of wholeheartedly serving patients and the courage to explore and innovate and ultimately to cultivate high-level pharmacy talents with the coordinated development of knowledge, ability and quality.

## **FUNDING DETAILS**

This work was supported by the [Project of Talent Training Quality and Teaching Reform of Higher Education in Sichuan Province] under Grant [number JG2021-1026] and [Project of Teaching Research and Reform of Southwest Medical University] under Grant [number ZXM-1, ZXM-12].

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ABBREVIATIONS

**CHAOXING:** ChaoXing Learning App; **MF:** Microfiltration; **UF:** Ultrafiltration; **JG:** Project of Talent Training Quality and Teaching Reform of Higher Education in Sichuan Province; **ZXM:** Project of Teaching Research and Reform of Southwest Medical University; **PLOS:** Public Library of Science; **SD:** Standard Deviation; **IM:** Instant Messaging; **LMICs:** Low- and Middle-Income Countries; **WHO:** World Health Organization.

## SUMMARY

This study aims to investigate the construction and application of process evaluation in assessing performance in pharmacology experimental teaching. The feedback from teaching practice indicates that the process evaluation of students' performance in pharmacology laboratory teaching can improve students' knowledge mastery, stimulate students' innovative thinking and enthusiasm in experimentation. This performance evaluation strategy can be used as a supplement to traditional teaching performance evaluation to improve the overall competency level of students and teachers. In addition, this provides some room for development for the integration of process evaluation in pharmacology teaching reform.

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**Cite this article:** Li H, Liu L, Li M, Sun Y, Liu M. The Construction and Application of Process Evaluation in the Grade Evaluation of Pharmacology Experiment. Indian J of Pharmaceutical Education and Research. 2025;59(4):1238-44.