

# Discussion on the experimental teaching practice of the course "Soil and Fertilizer Science"

Yifei Liu<sup>1, a</sup>, Xiumei Zhan<sup>1, b</sup> and Xiaori Han<sup>1, c</sup>

<sup>1</sup>College of Land and Environment, Shenyang Agricultural University, Shenyang 110161, China.

<sup>a</sup>liuyifeiscience@163.com, <sup>b</sup>liuyifei@syau.edu.cn, <sup>c</sup>95174006@qq.com, <sup>c</sup>hanxiaori@163.com

**Abstract.** The Soil and Fertilizer Science is a compulsory basic course in agronomy, horticulture, and other relative majors. And the experimental teaching part in this course is an important teaching link to develop students' practical application ability, and it has a positive contribution to students' learning theories of crop cultivation, rational fertilization and agricultural environmental protection and enhancing practical skills in agricultural production. To meet the cultivation target of research application talents in our university, we will discuss the teaching contents, teaching methods, and assessment methods of the experimental class to improve the research ability and innovative application ability of students and provide teaching references for the cultivation of research application talents.

**Keywords:** Experimental teaching; Soil and fertilizer science; Teaching reform.

## 1. Introduction

Experimental teaching is an important part of the education of agriculture-related majors in many agricultural universities globally, a key teaching step to promote talent cultivation planning in all aspects and to improve teaching level and quality, a prerequisite to prompt the cultivation of high-quality talents, and one of the basic ways to improve the student's practical ability. Soil and fertilizer are important agricultural resources. Soil and Fertilizer Science is a compulsory basic course set up by Shenyang Agricultural University according to the characteristics of agronomy, horticulture, and other majors. The course has 48 class hours, of which the experimental part has 16 class hours. Soil and Fertilizer Science is a practical course, which mainly studies the basic theories, basic properties, and related analytical test methods and techniques of Soil Science and Plant Nutrition so that students can master the basic methods of soil knowledge, soil use, and soil modification, and the principles and techniques of scientific fertilization more comprehensively, and then serve to promote agricultural production and the development of sustainable agriculture<sup>[1]</sup>. The experimental part is an effective way to consolidate and deepen theoretical teaching, and an important way for students to work in agriculture to solve relevant practical problems after graduation; the course is closely related to the research topics of undergraduate and graduate majors in agronomy, horticulture and other majors, and provides a certain basic guarantee in agronomy, horticulture and other professional scientific research [2]. In order to improve the teaching quality of experimental courses and gain good teaching effect, the research group explores the teaching reform from several aspects such as experimental teaching content, teaching methods and assessment system.

## 2. Discussion on the practice of Soil and Fertilizer Science experimental teaching reform

### 2.1 Pre-course video lecture combined with class discussion to improve the teaching process

The experimental teaching of the course "Soil and Fertilizer Science" often adopts the operation mode of combining theory with practice, the teacher firstly uses part of the time to teach the experimental principle and steps on the blackboard, and the students only need to operate carefully according to the experimental steps. Setting only 18 hours of experimental classes is already a serious shortage, and this teaching method is a waste of valuable class time. In addition, the

unidirectional teaching method also hinders students' subjective initiative and limits their ability to develop independent thinking [3]. To solve this problem, the research group used video distribution before class and heuristic discussion teaching. Recorded lesson videos are sent to students before the class. It vividly and intuitively demonstrates the experimental process, which is easy for students to learn and understand. Preview, which can improve the efficiency of listening to lectures, is one of the important links in the learning process. Students are required to prepare carefully before the experiment and clarify the purpose, task, requirements, key points, and difficulties of the experiment. And make good pre-study notes and listen to the class with questions. In class, students are required to answer a series of heuristic questions to test their preview effect and their grasp of the experiment. Classroom discussion is one of the main external expressions of students' cooperative learning, and it is an effective and important way to achieve teaching goals in teaching. Soil and Fertilizer Science experiment course advocates "autonomy, cooperation, and inquiry". Therefore, it is taught in the form of classroom discussions. The interaction of question and answer can arouse students' positive thinking, and enable students to oppose, ponder, feel, and debate in the process of discussion, which is conducive to cultivating students' competitive consciousness and cooperative spirit, and developing their communicative ability. The course content is fully integrated with the teacher's research and domestic and international research developments for knowledge updating, to achieve a good teaching effect while further enhancing students' interest in scientific research.

## **2.2 Focus on the cultivation of students' ability to analyze experimental results**

The ability of students to analyze experimental results can reflect whether they have mastered experiments. Analyzing the results of the experiment is also a way to improve students' ability to analyze, summarize and solve problems, and can lay a good foundation for students to carry out scientific research in the future. The research group assesses students' mastery of experiments through two forms of experimental class discussions and reports. First of all, students can seize the opportunity to meet uncertain problems in the experiment and discuss the problems in time. Even after the experiment is finished, the students should be asked questions such as what are the shortcomings of the experimental results. What caused it? What should be noted if the experiment is restarted, etc? Asking questions can reflect students' mastery of knowledge, which is conducive to developing the ability to analyze and solve problems. In addition, students are required to analyze the experimental results and set up open questions, which are attached to the experimental report book in the form of homework. In the past, teachers used to assess students' experimental scores under whether they got the correct experimental results, but now they focus on the ability to analyze experimental results and answer open questions in the report book to evaluate students' experimental scores. Try to train and urge students to improve the ability of independent thinking and problem-solving, and further train students' innovative spirit and practical ability.

## **2.3 Modify the proportion of experiments and assessment methods, raise awareness among students**

The experimental class is only a part of the course "Soil and Fertilizer Science", and the grade accounts for a relatively small percentage, 20% together with the usual grade. As there is only one lecturer in the experimental class, but there are many students, the teachers could not test each student's practical operation ability, and some students are fishing in troubled waters. Therefore, the quality of experimental reports is often regarded as an important criterion to evaluate students' experimental results. Lack of examination supervision, students think that they can get high scores, if they write good experimental reports, so they do not pay enough attention to experimental operations. Experimental teaching assessment should focus on effectiveness. The establishment of a set of scientific experimental course assessment methods and scoring rules is conducive to stimulating students' experimental interest and personality development, improving their experimental ability and experimental design ability, and cultivating their experimental quality and

innovation ability [4]. Based on this situation, the research group increased the proportion of experimental scores and ordinary scores from the original 20% to 30%, and let students pay attention to the experiment from the assessment system. In addition, the research group set up a random check assessment session for experimental operation. The assessment result is included in the experiment result to improve students' learning initiative. In order to save time, the assessment only operates key steps, combined with a language description. For example, the heating digestion of plant samples takes a long time. It only needs to be operated to put the heating digestion tube into the heating digestion furnace and adjust the temperature. The process of adding hydrogen peroxide - heating - cooling - adding hydrogen peroxide and the color change is described in language. To motivate the whole group of students to actively participate in the experiment, one member of each group is randomly checked in each lesson for experimental operation assessment. And the result is regarded as the result of the whole grade, to urge the group members to supervise each other and make progress together.

#### **2.4 Set up comprehensive design experiments to improve students' innovation ability**

Experimental teaching is the core of the basic practical level in the practical teaching content system. To cultivate students' innovative ability and improve students' comprehensive quality, the type of experimental project should be set in conjunction with the different phases of the student's basic capabilities, so that there are both basic verification experimental training and comprehensive experiments that can reflect the comprehensive knowledge application of a course or multiple courses associated with it, and the students' experimental skills and methods. In addition, there should be comprehensive experiments in which the teacher proposes experimental objectives and requirements, and students design their experimental schemes and complete them independently [5]. For example, based on the original validation experiment on plant nitrogen and phosphorus determination, the practical operation process from plant sample acquisition, preparation, treatment, and determination is given to students to design a comprehensive experiment to solve practical problems in agricultural production, so that students can participate in improving their independent thinking and problem-solving skills. This can also fully mobilize students' initiative and promote active and creative thinking. The students were encouraged to bring back samples from their hometowns, and travel places, or collect samples in conjunction with the experimental design in their thesis. This is a great way to stimulate students' interest and make the purpose of learning clearer, and more practical. The experimental operation process is student-led, and the teacher only provides guidance. After the experiment, students are required to fully analyze the experimental results and judge the rationality of the results based on theoretical knowledge and solve the pre-set issues in experimental design.

### **3. Summary**

The purpose of a comprehensive design experiment is not only to master the practical skills of Soil and Fertilizer Science but also to consolidate the theoretical knowledge. In a word, the comprehensive experiment is conducive to training students to improve their problem-solving ability, experimental hands-on ability, data processing ability, and the ability to consult references. Through the exercise of comprehensive experiments, students can apply their knowledge, analyze problems, and solve them independently. This approach transforms knowledge into ability and cultivates students' innovation ability and preliminary scientific research ability. It is of great significance to expand students' comprehensive quality.

## References

- [1] Liu Yifei, Han Xiaori, Yang Jinfeng, et al. Teaching experience in courses of soil and fertilizer science for horticultural science major. *Advances in Economics, Business and Management Research*. 8(2015): 931-935.
- [2] Liu Yifei, Han Xiaori, Zhan Xiumei et al. Teaching experience of soil fertilizer course in horticulture specialty. *Journal of Chinese Science and Technology Information*, 17(2012): 146-148.
- [3] Liu Yifei, Han Xiaori, Song Qiaobo et al. Reform and Practice in the Experimental Course Teaching for Soil and Fertilizer Science, *Advances in Social and Behavioral Sciences*, 8(2015): 344-346.
- [4] Liu Yifei, Han Xiaori, Wang Yan et al. How to reform experiment courses of soil and fertilizer science. *Advances in Economics, Business and Management Research*. 9(2015): 636-641.
- [5] Liu YF, Han Xiaori, Wang Yan et al. The experience and reform for soil and fertilizer sciences experimental teaching. *Advances in Education Sciences*, 11(2015): 145-149.