

# Research and Practice on “Cognition, Innovation and Independence” 3-Level Optical Fiber Experiment Teaching

Tao Zhang<sup>1,2</sup>, Caixia Cui<sup>3\*</sup>, Chengguo Tong<sup>1,2</sup>, Zhiyong Tao<sup>1,2</sup>, Yaxian Fan<sup>1,2</sup>

<sup>1</sup>School of Information and Communication, Guilin University of Electronic Technology, Guilin 541004, Guangxi, China.

<sup>2</sup>Academy of Marine Information Technology, Guilin University of Electronic Technology, Beihai 536000, Guangxi, China.

<sup>3</sup>School of Economics and Management, Guilin University of Electronic Technology, Beihai 536000, Guangxi, China. E-mail: zhangt02@163.com

Fund Projects: This work was supported by Innovation Project of GUET Graduate Education (No. 2020YXW16), partially supported by the Fund of Guangxi Key Laboratory of Wireless Broadband Communication and Signal Processing (No. PF19113P), and by the Foundation of Guilin University of Electronic Technology (No. HKY19002).

---

**Abstract:** Optical fiber experiment teaching is an important step during the process of university talent training with independent innovative ability. Therefore, we constructed the teaching system of optical fiber technology from experiment teaching, “cognition, innovation and independence” 3-level training. This multidimensional collaborative innovative training system effectively promoted the ability of student’s independent innovation.

**Keywords:** Innovative Practice; Independent Innovation; Multidimensional Collaborative Teaching

---

Optical fiber technology is the key component of modern optical communication technology<sup>[1]</sup>, sensor technology<sup>[2]</sup>, and analysis and measurement technology<sup>[3]</sup> and so on. It is also an important support technology of national information infrastructure<sup>[4]</sup>. In some talent training plans of the university, optical fiber relevant courses such as optical waveguide theory, optical fiber communication and fiber sensor have become one of the major courses. These courses have not only the characteristic of multi-crossed discipline, but also involve the theory and the experiment contents. Thus in the process of the experimental teaching, how to consider the experiment operability and level-division teaching becomes very important for developing student’s ability and further deepening experiment teaching reformation. This paper aims to explore how to enhance the student’s creative and practical ability of the modern optical fiber technology based on “cognition, innovation and independence” 3-level experiment teaching. The first level experiment module is to trigger the student’s curiosity and further foster their basic experiment skills in the fields of optical communication, fiber sensor and device application etc. The second level experiment module focuses on the student’s innovation training with the help of some design experiments, so that they can design experiment process and finally accomplish it by themselves, rather than following the manual instruction. The third level teaching encourages students to participate off-campus innovation and entrepreneurship competition so as to realize the student’s independent innovation of optical fiber technology.

# 1. Construction of 3-level experiment teaching on optical fiber technology

Optical fiber technology experiment must keep talent training as the central task teaching to improve the student's scientific quality and foster their creativity. Therefore, it is necessary to construct the teaching system from two aspects, i.e. experiment teaching and talent training mode. Firstly, the experiment teaching centers on teachers. It aims to change the teacher's educational concept and carry on reformation and construction of course system, course content and teaching mode and so on. On the other hand, the talent training mode emphasizes the students as main body. During this stage, the teaching gradually realizes the process of "cognition, innovation and independence" by successively implementing optical fiber technology basic experiments, design experiments, and off-campus innovation and entrepreneurship competition.

## 2.1 Course experiment teaching method

Regards to course content, we have firstly compiled the characteristic textbook "Optical Fiber Technology Experiment" based on years of teaching practice and relevant corporate research. The textbook not only includes subject frontier knowledge, but also involves in practical application and theoretical knowledge. While in the aspect of teaching method, a kind of comprehensive model is adopted including MOOC, Micro-lecture, flipped classroom and face to face communication between teacher and students, rather than the traditional class.

## 2.2 3-level talent training mode

The first level mode is "cognition stage". Under the exam-oriented education, the college freshmen almost have lost the curiosity of knowing things and exploring nature. How to arouse the student's instinct of exploring the nature law and to ignite the sparkle of their curiosity has become the primary goal for the teaching task. Therefore, we take various measures to culture the freshmen's curiosity. A serial of courses are merged into the student's plan program, such as freshman seminar, regular lecture on scientific research experience of optical fiber scientists, and picture exhibition and video introduction on new discovery in fiber. In addition, some basic experiments are also carried out to enable the students to perceive the optical fiber communication principle and fiber sensing application. These bring students both a visual feast and attracting scientific problems. Meanwhile, these guide the students to enjoy the pleasure of optical fiber and train their cognition on innovation.

The second level mode is "innovation stage". Firstly, we set up some designable experiments and comprehensive experiments to cultivate the student's research habits and improve their practical abilities. In addition, we have also designed and established an innovation center. In this center, the student can do some DIY projects they are really interested in. Meanwhile, this center carries out some periodic contests of scientific and technological invention, and scientific drama play. Various practical activities greatly enrich the spirit of science and technology innovation. Next is the final level of "independence stage", namely self-innovation. The students are encouraged to participate in some national college student innovation and entrepreneurship competitions or training programs. In this stage, the students need to pose innovation thought, find out the solution to implement it, and finally complete the project. Thus, the students will have merit of independent innovation.

# 3. Implementation of 3-level experiment teaching on optical fiber technology

In order to achieve the talent training task by making use of "cognition stage" "innovation stage" and "independence stage", it is necessary to take effective measures during the process of experiment teaching.

## 3.1 Open experimental teaching

Based on the course selection system, the students can freely choose the class time, but not be limited in the teaching calendar timetable. Moreover, some mixed teaching mode is introduced by use of internet such as MOOC, Micro-lecture and online-class. To solve this problem that it is seriously disconnected between the experiment contents and the students with different profession background, it needs to provide as many experimental items as possible, including comprehensive and innovative experiments, to develop the student's ability of solving practical problems. These experiments can supply the students with devices or elements to obtain good results. In addition, the students can also solve the problems in group

discussion and cooperation when they encounter difficulty. On the other hand, the students will be irregularly brought to the enterprise or corporation for communication and learning, or the enterprise engineers will be invited to have special technical classes at school.

### 3.2 Improvement of experiment teaching method and experiment technology

In accordance with the student's aptitude, they are taught with different teaching mode. Some gifted students will be supplied with some advanced research-oriented experiments, and they are asked to finish the project by teamwork. These measurements fully stimulate the student's enthusiasm of research interesting and initiative, and also create an atmosphere of scientific exploration to improve their innovative practice ability.

Meanwhile, the experiment technology research is promoted to a very high position which plays an equal role with science research in teaching staff. Thus it activates teachers' motivation to participate in the experiment technology research and further obtain research achievement. In recent years, the experimental teaching staff has taken on some teaching reform projects including provincial projects and school-level projects. Some self-research equipment involved in student participation reaches a dozen.

### 3.3 Practice of student's independent innovation

The core task of experiment teaching is to let students have independent innovative ability above optical fiber technology. In order to realize this goal, there are two concrete steps adopted: innovation training program and enterprise project practice. For one thing, some students are encouraged to participate in college student innovation and entrepreneurship training program from nation, province or school-level. They are asked to independently finish the program from idea presentation, implementation method until final completion in a team or alone. Moreover, the students can participate in innovation competition such as National Student's Optoelectronic Design Competition, "Challenge Cup" business plan competition, and National Undergraduate Electronic Design Contest etc. For another, by use of school-enterprise cooperation, the students can get the chance to involve in the processing of the enterprise product development or help enterprise to solve technique problems. Especially, for some creative and innovational products designed by students, they may apply for patent protection.

## 4. Conclusion

With improving the student's creativity as the starting point, we constructed the teaching system of optical fiber technology from experiment teaching, "cognition, innovation and independence" 3-level training. Moreover, we took more measures to promote the effective practice of student's independent innovation. This teaching system is a multidimensional collaborative innovative training system, which was composed of teaching process, teaching and research process, practice process, and enterprise process. At present, this system has been implemented in School of Electronics and Information of our university.

## References

1. Wang T. Design application and development trend of optical fiber technology in communication engineering. *Chin New Tele Communs* 2020; 1: 6-7.
2. Zhang X, Ding Z, Hong R, *et al.* Phase-sensitive optical time-domain reflectometer distributed optical fiber sensing technology. *Acta Optica Sinica* 10 Dec 2020. p1-27.
3. Sun J, Wang T, Dai Y, *et al.* Multi-parameter measurement sensor based on no-core fiber. *Acta Physica Sinica* 10 Dec 2020. p1-20.
4. Garfield M J, Watson R T. Differences in national information infrastructures: The reflection of national cultures. *Journal of Strategic Information Systems* 1997; 6(4): 313-337.