How to Cultivate Students' Open Thinking in Practical Teaching

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Abstract. In the context of the return project, the practical teaching is investigated. On the basis of the investigation, this paper puts forward the method of "Marginalization" and "Impossible". Result shows that these two approaches can cut the student to the theory of "superstition", so as to cultivate students' open thinking.

Introduction

At the end of the 20th century, American engineering education presents the tendency of drifting from engineering practice, the reformism idea "Return Engineering" arises immediately at the same moment, which caused engineering education in the United States turned to pay attention to the actual project and the systematic project itself. The United States believes that engineering education should return to its original essence, that is, to focus on the creation, design and ability to invent of young engineers\cite{1}. Similarly, in September 2004, the Federation of European Engineer Associations (FENAI), launched the European engineer certification program in order to establish a unified engineering education accreditation system.

In our country, in 2010, the Ministry of Education launched the "excellent engineer education and training program" officially, this plan is mainly to fit our country’s plan to take a new road to industrialization, accelerate training high-quality engineering talents to fit the needs of economic and social development in the future. How to carry out the reform is an urgent problem to be solved in China's High Engineering Education in the face of the large number of students in colleges and universities of science and engineering.

In view of our current education, especially the practical education,\cite{2} \cite{3} \cite{4} \cite{5} comes up with the problems of practical teaching in our country, at the same time it puts forward the reasonable practical teaching system. However, from the author’s perspective through years of practical teaching, students' fixed thinking models one of the problems in the teaching of high education. Therefore, the author takes the specialized experiment of telecommunication in Xidian University as sample to carry on the research; based on this research, some reforms of experiments have been carried out. Results show that setting up the experiment links properly leads to students' open thinking.

The Current Situation of Experimental Teaching

The practical teaching of "Communication Principle" course in School of Telecommunications Engineering in Xidian University consists of three parts: the first one is
experiment with experimental box, mainly to allow students to verify the theory they have learned from classes; the second part is software simulation, using SystemView to simulate a communication system, enable students to develop the concept of system; the last part is the hardware-in-the-loop simulation, using the signal generated by the hardware to verify the theory.

**Hardware-in-the-loop Simulation**

The equipments used in this experiment are imported. They use hardware to produce a real signal. Students log in to the server through specific software. The server uses the technology of time division to process the request of the students. Then the results are collected and sent to the students to ensure that each student's different and variable experience.

From the server activity record of Fig. 1, students' experimental time distribution in various periods, mainly concentrate at about 4:00 pm. Therefore, one of the advantages in hardware-in-the-loop simulation lies in it liberates both teachers and students. Students can arrange their time flexibly and teachers can devote themselves to experimental research.

By marking the reports students have submitted, we can find that most of the students just be perfunctory, did nothing about theoretical analysis which could be connected with practical problems. According to these reports, most of the students don’t understand the importance of experiment and don’t have the profound and clear understanding of the purpose of the experiments establishment.

**Software Simulation**

SystemView is employed in this part. The software is applied to simulation of systematic level which is very helpful to understand the composition and principle of the whole system.

According to the on-the-spot teaching and the 400 copies of the report sampled from 2013 to 2015, the software experiment has the following characteristics:
a) High repetition rate: browsing students’ report, we find the only difference between the students report is the name on cover.

b) Less effective in results: Asking questions in the teaching process, we find many students’ results are correct, but they cannot give professional explanation about the waveform. The concept of the simulation system is even unclear to them. This shows that the students isolate the experiment and theory. When acknowledged the experimental requirements, they only cared about getting the final result but pay no attention to the reason of those appearances.

Experiment with Experimental Box

The experimental box of Communication Principle experiment is self-made, the purpose is to verify and help students have deeper understanding of the theory. But according to the experiments and investigation in 2013 and 2015, students just put interest in accomplishing the experiments and cared little about the correctness of data and waveforms; Since the meter has been developed to the digital instruments, many instruments can return some results when they are turned on, therefore many students often make jokes of their experiments as "migrant workers" experiments.

The investigation of the three different types of experiments above shows that the design ideas of existing experimental equipment are working for the verification of a theory or design. Because of this premise, the experimental results of different people must be very similar. Theory teaching always consider from the order, it rarely consider the conditions which cannot be guaranteed. According to this angle, the device completes the experiment when start-up, and the remaining work is to record the data. For example, in simple delta modulation, we tend to focus only on the two boundaries that allow students to observe the codes, students often record the waveform only. Thus, the practical teaching lost its practical significance, and the students lost their interest because of the single experiment result.

How to Cultivate Students' Open Thinking

From the results in 2013 to 2015, we have made a conscious reform in the experiment of optical fiber communication.

1) "Marginalization" of teacher, the so-called marginalization is to let the teacher from the original "babysitter" status turn into a correct sense of the "guiding people". Experiment is not only supplement of the theory, more important, it is a verification of the method. Therefore, teachers should guide the students how to get the results rather than make themselves the "babysitter" which makes students themselves leader during their experiments.

2) the non uniqueness of the experimental results: the so-called non exclusive is the experimental data respect to the experimental results. Since the experiment is also measured, the results are decided by measurement instruments, equipment and the environment. In this regard, the student's measurement results should be questioned so that we can change the students’ “finishes their experiment while they open their instrument”.

3) Set the impossible result, this is the core of the experiment. Our students too superstitious about the theory and instrument without considering people’s subjectivity in experimental process; they have no aware of the theory source, the application which lead the students to rigid thinking.

After changing the teaching method, we reinvestigate the students’ experiment results more than 700 copies. The results show that about 70% of the students said their experiment was
touched that their thinking were heavily ossified, and experiments let them know the formula from a new perspective.

Students in the data analysis process has found that sometimes the data is impossible, but due to excessive superstition of the theory formula they cannot break the shackles of their rigid thinking; In addition, the students also said that they understand the theory is used to solve the actual problems rather than just for the examination. This shows that as long as the design is reasonable, the students can be trained to get the open thinking.

**Summaries**

This paper first discusses the current situation of practical teaching. Then on the basis of the survey of three years, the author designs targeted experiments. The results show that changing the status of teachers in the practical teaching while setting impossible data in the practical links can force students to think, so as to make students’ thinking open up.

**References**


