

# Experimental Teacher's Extracurricular Guidance to Improve the Quality of Applied Undergraduate Education

Chi-Fu Yao<sup>a,\*</sup> and Su-Ying Zhang<sup>b</sup>

Department of Engineering, Shanghai Second Polytechnic University, Shanghai, China

<sup>a</sup>yao\_chifu@163.com, <sup>b</sup>191781599@qq.com

\*Corresponding author

**Keywords:** Experimental teachers, Answering questions, Application-oriented undergraduate; Extracurricular practice, Interest-inspired.

**Abstract.** Through the anatomy of the important indicators of the applied ability of students in the application-oriented undergraduate education, this paper combines with the current difficult situation in the current teaching plan to complete this index. It points out that the guidance and leading role of the high-skilled experimental teachers in students' extracurricular practice enable to stimulate the students' interest in learning, meanwhile to promote the utilization of the laboratory, also to improve students' ability of innovating and solving practical problems. Through the practice and exploration, and data analysis, it proves that this method has a good teaching effect, and discusses the measures and details that should be paid attention to and support when implementing this method.

## Introduction

The popularity of the application-based undergraduate pilots in the society has also made the “applied undergraduate pilot program” a hot cake, so that many local colleges and universities to strive for this pilot as an important means and work goals to enhance professional competitiveness. The training of applied undergraduate talents is so important and urgent, but there are still some places to be improved in our current training process, such as the problem of less practice in the first two years of the university and the lack of integration of practical elements in the lower grades, and the problem that the teacher team overemphasizes the high degree of education and research-oriented, while the proportion of practical teaching teachers is insufficient. Moreover, some leaders have insufficient understanding of the role of experimental teachers and experimental technicians in the education and teaching of students, and experimental teachers and technicians have insufficient understanding of their importance and necessity in education and teaching. All of this makes it a very meaningful work to explore some deficiencies in the laboratory and experimental team to make up for the general teaching contents of applied undergraduate.

## New Requirements of Application-Oriented Undergraduate for Talent Training

As China has entered "the Internet plus" in recent years and gradually towards the era of AI and Industry 4.0, the development goals has also changed from manufacturer of quantity to one of quality, strong maritime country, aerospace power and so on. At this stage, we need a large number of craftsman level engineers who understand the mechanism, design and operation. Applied undergraduate talents are different from academic research talents and practical skill-based talents. The society has specific requirements for the connotation, quality and ability of applied undergraduate talents.[1] Applied talents are required to solve complex real-world scenarios, which makes them have to have a solid theoretical foundation and multidisciplinary ability.[2] This makes it necessary for them to take practical and applied professional courses, but also to fill up enough public and professional basic courses, which make them in the freshman and sophomore when they have to cope with and busy with the course of the school and professional basic courses. Before the start of junior, it was basically impossible to get involved in the professional application scenario practice that they yearned for. This causes some students to lose patience, and some even feel disappointed, thinking that this profession can't learn real stuff, thus losing the fighting spirit of learning, spending time playing computer games and sleeping.

### **There is Still a Gap between the Current Training Program and the Application-Based Undergraduate Program Requirements**

Today's society requires field engineers to master a solid basic theory of engineering technology and technical specifications, have strong technical thinking ability, be good at technology application, can use knowledge to solve practical engineering problems, and transform science and technology into real productivity and actual contribution rate. Field engineers often face complex and comprehensive practical production technology problems. In order to meet such requirements, the current application-oriented undergraduate pilot programs has difficulties. [3] The reason is that under the background of reducing credits and reducing credit hours, we have not yet established a set of methods and ways for students to make full use of the after-school time for systematic practice. Moral education, foreign languages, mathematics and other public courses, professional basic platform courses almost accounted for the application of undergraduate students in the first two years, learning professional knowledge and engaged in professional practice mainly in the junior year, and after the third year, the school has strongly recommended them to conduct off-campus internships. In this way, they may only get the course study and practice of professional courses in their junior year, and it is difficult to get the opportunity to develop comprehensive practical ability. Like the PBL (Problem-Based Learning) teaching method, students are placed in complex and meaningful problem situations, and students work together to solve real-life problems in the form of group cooperation, to learn the knowledge implied behind the problem, to develop the ability to solve problems. Cultivating students' ability of autonomous learning and lifelong learning can only be cultivated in the extracurricular time before the junior year. [4,5]

### **Experimental Teachers Can Play a Greater Role in Early Practice Guidance, Interest Orientation, and Innovative Practice**

Teaching and scientific research are two central tasks of colleges and universities. Experimental teaching is an important part of accomplishing two central tasks. The level of university laboratory construction and the quality of experimental teachers are one of the important indicators for testing and measuring the level of a university. If the level of laboratory construction is "hardware", then the quality of the experimental teacher is "software". Therefore, in a certain sense, the quality of experimental teachers plays a decisive role in improving the quality of experimental teaching and the level of scientific research in colleges and universities. Re-positioning the experimental teacher's work is a renewal of the concept of experimental teaching and a prerequisite for the construction of a new team of experimental teachers to adapt to the reform of experimental teaching. [6]

### **It is Necessary to Lead Junior Students to Get in Touch with Professional Practice and Innovation**

The focus of applied undergraduate colleges should be on "application". The practice teaching process is the best embodiment of "application" and it is an important means to cultivate students' practical ability and innovation ability, and to improve their professional quality and employment competitiveness.[7] The lower grade students, especially the freshman students, have just stepped into the university gate from high school, with curiosity and yearning when applying to school.

At this time, they are very interested in what kind of field they can work in, if we can use their "impulse" to contact professional practice in the training plan, take advantage of the situation, and guide them into the cognition and exploration of professional practice in time, which will make their momentum well lead to early professional practice. Make their dreams come true when they apply for the profession, which also prevented them from falling into the "lower grades of loss and low tide" [8]

### **Normal Teaching Arrangements Make It Difficult for Lower Grade Students to Engage in Professional Practice and Innovation Activities**

According to the regulations of the Ministry of Education, undergraduate students must complete a certain number of credits and credit hours, such as political courses, foreign language courses, mathematics and other public courses, in addition to physics, physical education courses. Many

engineering students in their first and second grade have little access to professional practice course, and only in their sophomore year will there be some professional basic classes.

This has caused some students to lose patience, while others are skeptical about whether they can learn the real thing at the university. This has led to the phenomenon of "second grade downturn". Many undergraduate colleges' innovative projects and "three small project" applications have clearly announced that they mainly face junior students. They feel that only juniors have sufficient professional foundation and professional ability to engage in innovative activities, which also makes freshmen and sophomores rarely participate in innovation activities.

### **Experimental Teachers Are Familiar with the Lab Environment and Have Sufficient Time to Guide Practice**

Experiment teachers generally manage the assets of the lab at the same time, and often maintains the hardware and software configuration of the device, so they have a better understanding on what experiments can be performed on the device, and how to use the device skillfully. Experimental teachers generally implement the shift system. If it is not because of the leave, they come to the lab every day. A lot of time is engaged in equipment management, experimental preparation, development of new experiments and preparation of experimental instructions, etc. If students are engaged in practical activities in the laboratory. It is easy to find the guidance of the experimental teacher, and the guidance is superior to the full-time teacher in terms of time and place.

### **Experimental Teachers Have Sufficient Practical Teaching Level and Innovative Ability**

As the applied undergraduate colleges have passed the assessment of teaching level, the experimental technical teams of colleges and universities have been enriched and improved. Not only are the staff available, but the academic qualifications are generally upgraded to the master's degree and above. After several years of exercise in laboratory and experimental teaching, many experimental teachers not only have high technical level and rich teaching experience, but also basically have technical certificates for national certification. Some undergraduate colleges' experimental teachers have a large number of technical certificates, utility models and invention patents are also a lot. This is enough to prove that there is no theoretical shortcoming for experimental teachers to engage in practical teaching and innovation activities for undergraduate students, and there is no lack of technical level and lack of innovation ability.

### **The On-Duty Answer Questions Provide Conditions for Students to Freely Choose Their Learning Content**

The implementation of the "Key Teacher Incentive Program" in Shanghai not only guarantees the number of times a teacher can go to school every week, but also brings an opportunity to solve the problem that it is difficult for students to find teachers in extracurricular time. It is stipulated that twice a week during the day to answer questions and one evening class, so that students can come to the experimental teacher to inquire about the use of experimental equipment, understand the experiments that the laboratory can open, especially design and complete the experiment with the experimental teachers, which is very easy to achieve things. In the past, because the experimental teachers had a lot of work, they needed to work between multiple laboratories and school functions, attend meetings or classes, which made students often unable to find experimental teachers when they wanted to ask some experimental or practical problems. Sometimes even if it is found, because the experimental teacher has other important things and can only rush to answer the questions and then to leave immediately. In this case, the students are sometimes confused, thinking that the teacher is not good or feels badly answered. Over time they are not willing to consult experimental teachers and enthusiasm of coming to the laboratory has also declined. But now it is different, the "Key Teacher Incentive Program" allows teachers to choose their own time and place to answer questions, and teachers are not allowed to leave. Even if there are important things need to leave, they should leave a contact number and explain the reason. This allows students to contact the lab teacher every time they come.

## **Exploration Practice has Achieved Obvious Results Preliminarily**

### **Using Case Teaching Method to Stimulate Students' Interest in Learning and Make Them Challenge**

What is the effect of answering questions? Whether there are students coming, students are willing to come, the core is how to set the "question", this problem is solved, not only to make students satisfied after answering questions, but also because teacher's carefully designed "question" and associate with the relevant issues, or stimulate other thoughts, summing up the skills and laws that students do not imagine before.

If students like this guide very much, then they will be more willing to come to the teacher to answer questions. Therefore, it is recommended that the "question" should be derived from the curriculum but also higher than the curriculum, so that the students can understand, but there are still problems worth thinking about. For example, in order to introduce the VLAN technology of the switch, teachers can introduce the practical problem of "in a large office, how to isolate the financial group and the information operation and maintenance team", the financial sensitivity and the technical means of the information operation and maintenance team members make the problem full of challenges and imagination.

### **The Experimental Teachers Have Obvious Advantages in Practical Teaching and the Teaching of Interest in Answering Questions**

After the opening of the laboratory, the experimental content is extensive, students will come up with various problems encountered during the experiment. To solve these problems, the experimental instructors must have a solid theoretical foundation and rich experimental experience, especially sometimes it is necessary to have a good understanding of the experimental operation of the equipment, which has higher requirements for the instructor. [9,10] For example, network devices generally have built-in operating systems. Even if the same manufacturer, if the versions are different, the experiments that can be done are different. Due to the small differences in the environment, the designed experiments fail to achieve the expected results. Many teachers in the experimental class can't solve, only with the students explained that "there may be a problem with the equipment." There is no major academic paper requirement for experimental teachers in colleges, but there are strict requirements for the preparation of experimental instructions, the development of new experiments, and the use of proficient experimental equipment. If it is not a scientific research design experiment, the experimental teacher can be very competent, the equipment problems encountered in the experiment can be solved quickly and better, and the abnormalities caused by the experimental environment problems in the student experiments are easier to explain. Some devices are abnormal because of lack of stuffing, or bugs, which is generally known after consultation with the manufacturer. Full-time teachers do not deal with the equipment every day, it is generally not easy to find such anomalies, but the experimental teachers can have a more thorough grasp of the situation in the equipment. [11]

### **Data Analysis Shows the Obvious Teaching Effect**

Through teaching practice, using the undisturbed "legal" time of the class to answer questions, as an experimental teacher (or experimental technician), two classes a week, opened a "network design and configuration" interest class for the students of the first and second year. Introducing how the network is interconnected with Cisco Packet Tracer simulation and configuration, so that they can not only understand how the entire network is interconnected, but also configure the implementation step by step. When they learned that different designs have a big difference in the performance and availability of the network, and the effects of security, they are extremely excited and are full of confidence in the network engineering profession. Stimulating their enthusiasm for practice, but also indirectly inspired them to study the courses offered by the major. In order to analyze the leading role of the interest class more scientifically, the students who participated in the other two interest classes of "Web Application" and "Network Programming" will be counted together. There is a certain student scale, which will be more representative and persuasive. The following is a 2017-2018 spring semester to participate in the interest class and their two network engineering professional basic course results to analyze the impact of the interest class on their professional related course scores.

Table 1 lists the types of students' interest classes, time, and their two basic courses. As you can see from the table that some students only participate in one kind of interest, while others participate in more than two classes of interest.

Table 1 Student participation interest group and professional foundation course grades

StuNo.	Coaching content1	Coaching content2	Coaching content3	Time to study (hours)	Course A(score)	Course B(score)
	Design and Configuration	Network Programming	Network application			
S1			yes	12	46	65
S2	yes			24	67	71
S3	yes			18	67	64
S4			yes	6	71	82
S5		yes		16	74	71
S6	yes	yes		16	79	82
S7			yes	14	82	85
S8	yes			28	87	75
S9	yes			30	89	83
S10	yes			28	89	69
S11	yes	yes		32	90	91
S12		yes		28	91	88
S13	yes	yes		28	92	92
S14	yes			30	94	94
Average of the practice:					80	79
Average of the class:					64	72

It can be seen from Table 1 that the average score of the students participating in the interest class is significantly higher than the average grade of the class, but the improvement rates of the two courses are  $(80-64)/64=25\%$  and  $(79-72)/72=9.7\%$ , the difference in the rate of improvement reflects the difference in the relevance and contribution rate of the interest class to different courses.

Figure 1 below shows the distribution of the scores of the course A of the students of the interest class and the whole class. It can be seen from the figure that the scores of 64 points and below, the proportion of students in the interest class is less than that of the whole class, and the score segment between 85 and 100 points is higher than that of the whole class.

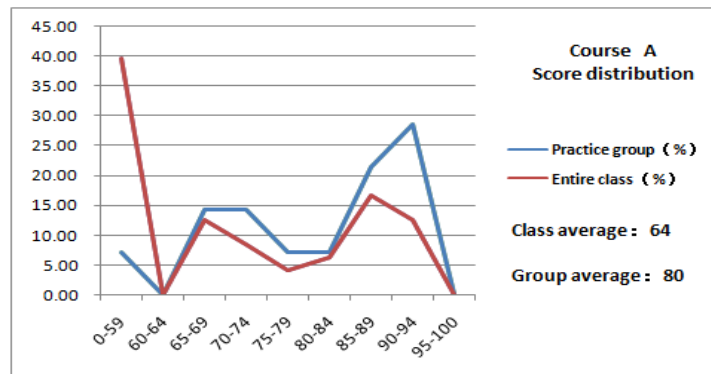


Fig. 1 Comparison of the distribution of scores of practice groups and class scores in course A

Figure 2 shows the distribution of the scores of the courses B of the students in the interest class and the whole class. From the figure, we can see that the scores of 74 points and below, the proportion of students in the interest class is less than the total class, and the score segment between 75 and 100 points is higher than that of the whole class.



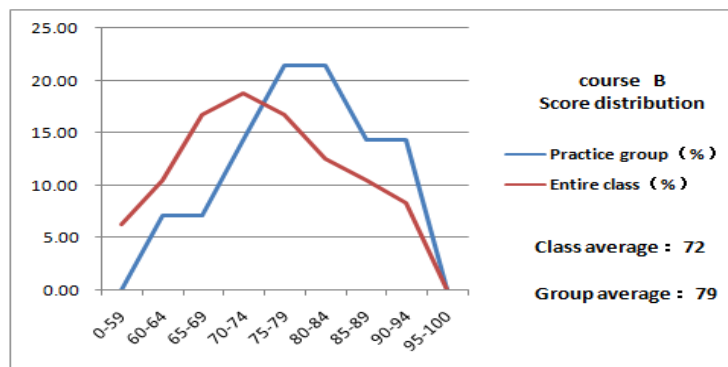


Fig. 2 Comparison of the distribution of scores of interest groups and class scores in course B

From the statistical analysis of the average scores and fractional segment distribution of the two classes, it can be seen that the scores of the students in the interest classes have been improved to varying degrees. At the same time, due to the content of interest classes and the degree of closeness of the relevant courses, the degree of improvement will also be different. Not only did the average score improve, but the achievement distribution also shifted to a high segment.

### Teaching Effect Analysis and Promotion Prospect

Through the practice leading role of experimental teachers, we can guide students to come into contact with professional practice at an early date, improve their confidence in the application prospect of this specialty, and thus promoting their enthusiasm for professional basic courses and related courses. From the statistical and comparative analysis of Table 1, Figure 1, and Figure 2, it is proved that the experimental teachers' extracurricular practical guidance can lead the application of undergraduate students, not only to prevent the lower grade students from producing "low grade confusion" syndrome, but also to make up for the lack of practice in the normal training plan. Not only make the students who get the practical guidance of the course better study the relevant professional courses, but also stimulate their study of other subjects.

Conclusion: How to expand the face of beneficiary students so that more students get extracurricular practice guidance? This not only requires conscious expansion of the guidance, but also the expansion of the strength of the experimental teacher, including the number and level, but also gives the experimental teacher more guidance on the time for students to engage in extracurricular practice. The laboratory is the most important part in the cultivation of talents, and it is also the means and foundation<sup>12</sup>. School leaders and personnel departments should also consciously guide students' extracurricular practice as an important part of experimental teachers when they develop job responsibilities, and provide them with certain institutional guarantees in terms of time, practical ability training and financial resources. Applicative undergraduate students can access professional laboratories and equipment from the beginning of the school, and cultivate exploration methods and research awareness at an early stage, so that their entire university period is immersed in the improvement and happiness of seeking education and learning, and then with the regular application of undergraduate courses, such applied undergraduate graduates, will become an application-oriented talent with a solid foundation and a good ability to find, analyze, and solve problems.

### Acknowledgement

This research was financially supported by the Key Disciplines of Computer Science and Technology of Shanghai Polytechnic University (No. XXKZD1604), the Experimental Major of Practical Undergraduate Shanghai (A30DB172202-4).

## References

- [1] Y.J.Pan, C.J.Liao, Quality and Assessment of Practice-oriented Undergraduate Talents Based on Social Needs, Higher Education Development and Evaluation. P51-59. 2014, 30(05).
- [2] Y.J.Hou, H.D.Zhu, Analysis on the Training Mode of Applied Undergraduate Talents, Shangqing. P174. 2018, (11).
- [3] X.L.Qian, Z.Y.Qiang, Comment on the Sustainable Development Mechanisms of Improving Experimental Teachers' Qualities, Research and Exploration in Laboratory. P218-220. 2009,12(28).
- [4] W.Hua, Research on Teaching Experiment of "Statistics" Course in Five-year Higher Vocational Education, Kaoshi Zhoukan. P153-154. 2013, 82.
- [5] Y.Jin, B.C.Yang, PBL Combined with the Answering Questions in the Teaching Reform of Chinese Medicine in Large Class Teaching, Education of Chinese Medicine. P82-85, 2017, 36(4).
- [6] K.B.Zhou, M.H.Chen, Pay More Attention to the Construction of Laboratory Staffs in Universities, Research and Exploration in Laboratory. P145-148. 2008,27(1).
- [7] Y.J.Hou, H.D.Zhu, Reform and Practice of Experiment Teaching of Materials Science and Engineering in Application-oriented, Research and Exploration in Laboratory. P201-204. 2016,35(2).
- [8] X.L.Zhu, Y.Y.Wang, L.Wang, Self-esteem and Learning Burnout of Higher Vocational College Students in Shanghai, Journal of Shanghai Second Polytechnic University. P60-66. 2009, 26(1).
- [9] W.J.Pang, Problems And Coping Strategies in the Opening of the Laboratory of Functional Computers in Colleges and Universities, Psychological Doctor. P352-353. 2017,33(23).
- [10] X.J.Cai, J.F.Zhang, Problems and Countermeasures in the Construction of Laboratory Open Projects in Local Colleges and Universities, China Modern Educational Equipment. P26-28. 2017,265(9).
- [11] H.R.Zhao, How Can Experimental Technicians Work In Explorative Experimental Teaching, Research and Exploration in Laboratory. P153-156. 2017,36(2).
- [12] J.N.Liu, Laboratory's Role Infiltrating into University's Functions, Research and Exploration in Laboratory. P1-4. 2004,23(6).