

Research on teaching reform and practice of applied optics design experiment

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Abstract: It is an important way to effectively improve applied optics experimental teaching effect and motivate the undergraduates' practice ability and creativity by means of scientific and systematic setting teaching contents and link. Based on the research and analysis of applied optics experiment teaching present condition at home and abroad, this paper aims to solve the existed problems and deficiencies during the experiment teaching in our university, and also puts forward some reform ideas and practice method from several aspects such as teaching thought, teaching content and mode, examination and evaluation and so on. Simultaneously, this paper also gives some suggestions on the future course development.

Keywords: Applied optics design, Experimental teaching, Reform and practice

Optics develops rapidly in recent years which has opened a new era, and it's also related to optical engineering . Applied optics is the theory and design of optical systems using optical instruments, which is indispensable to optical engineering technology and theory. Meanwhile, it's also the required course for undergraduate majoring in optoelectronic information science and technology. Students'

understanding towards applied optics directly determines the ability of solving related projects and scientific research. As far as we know, light is an important phenomenon in nature, which plays an indispensable role in the historical evolution and the production of human life. Therefore, the optics is also one of the earliest developed subjects, which is as important as geometry, astronomy, and mechanics [1]. Applied optics, which has strong applicability, are related to civilian and military. At the same time, we sum up two applied optics teaching characteristics through the usual teaching experience: one is that the basic concept is numerous and is easy to be confused. The other is that the physical symbol and formula will cause the confusion of knowledge. Therefore, in addition to learning theory, experimental teaching is also an indispensable important part of teaching, which can enhance students' understanding of knowledge. From the research, We find the present status of applied optical designed at home and abroad and analyzes its advantages and disadvantages. we puts forward the teaching in combination with the practical situation of our college's reform train of thought and practice.

1. The course of applied optics design

Optoelectronic information and technology is a new course in colleges and universities, which focuses on the basic principle of optical information science and technology. On the basis of this, we combine the optics, electronics and computer technology.

Nowadays, More than forty universities set up the course. Since it is just the beginning, the emphasis of teaching at universities, the system of course structure and the understanding of the teaching mode are different. Each course is different from others [2-6]. In general, the content of optical experiment is small, system structure is simple, classes are also relatively small:

Zhejiang university has set up "applied optics", which includes 17 hours' period combining four course design of experiment.

Tianjin university has only 4 hours' period combining applied optics and items optics.

In contrast, the course of applied optics design is more fulfilling, and its content on step-ladder, autonomy and innovation is sufficient:

The university of Arizona, ranked 64th in the world, set up more than 20 courses related to optics. The courses related to in-depth popular scientific research and cultivate the students' ability of the textbook knowledge into scientific research productivity by using optical industry.

Among them, the Geometrical Instrumental is compulsory education courses, the corresponding domestic colleges courses applied optics span for up to two school year teaching process.its teaching content is rich, high practicability, which is range from the basic optical theory to optimal design of optical system, its purpose is to let students understand and grasp firmly optical basic principle and application; The Fundamentals of Applied Laboratory and Practical optics are courses for undergraduate students. The former's major content is the Gaussian Optics, light source, optical system, the aberration theory, optical engineering technology and detection technology, etc. It can teach the students how to build optical experimental platform and carries on the optical measurement experiment according to their needs, thus understand the basic theory in geometrical Optics, Applied Optics.

The latter is in the service of science research, experiment device is often used at first, which tell us how specific application connected to the experiment. According to teaching content, the course is divided into three parts and respectively in the three semester classes. In addition, the institute also let the students to visit optical enterprises which gives students the platform to form a team with enterprise to do optical research , and let students study the optical industry standards in order to study optical software design [7].

Applied optics is still in the classroom instruction as the main body, the overall

framework is too simple, and few devices' are corresponding to auxiliary teaching content; Its only experiment content "applied optics design experiment" starts far away from the theory content, students learning related experiments already forget the theory content, so, the teaching effect is not satisfactory.

2. The existing problems in the application of optical design experiment course

Based on the current situation of the application of optical design experiment in recent years, a variety of reasons make it impossible to maximize the effectiveness of the teaching of optical experiments, according to our research and analysis, the main problems are the following:

2.1 The monotonous experimental teaching mode

At present, the application of optical design experimental teaching mode is the traditional teaching mode, the content is old and the structure is single. In the experimental class, what the teacher generally do is to teach on the basis of the experimental steps given by the textbook, step by step to lead the students to operate the experiment, this kind of the teaching method is understandable in the unity, But in the actual teaching process, only a handful of students is familiar with the experimental procedure and experimental instrument ,Even a lot of students are in accordance with the experimental steps on the teaching material, still can not successfully complete the experimental process. In this condition, the teacher will often help students to adjust the experimental instrument to a suitable location to facilitate teaching, while students just follow to the teacher or teaching steps to get experimental data, the reliability of data is uneven. Then for the experimental report writing, in order to successfully complete the report, many students fabricate or reference to other people's experimental data, resulting in most of the data are similar. it is often happened that teachers based on the final report of the experiment to evaluate the final results of the students, very few of them can refer to the quality of the students that they perform in the experiment, so that the experimental teaching has

lost its original meaning.

2.2 The old teaching content

The content of optical experiments in universities is based on the teaching materials, which are old and outdated, and the structure is aging, most of the experiments are the verification experiments of the principle, so they are not conducive to the development of students' thinking ability and the ability to apply theory. And in the teaching practice, with the limited number of experimental courses in the classroom, each class can only be used in turn, leading to not only students have less hours, but each class will be subject to time constraints. As long as the bell rang, the students had to leave the lab to make room for the next group of students. This way reduces the enthusiasm of the students, so that they lost the opportunity to continue to stay in the laboratory to look into the problem, and the idea of giving up comes into being, which is unfavorable of cultivating the ability of the students.

2.3 Limitation of experimental class

As we all know, the three components of optics are geometrical optics, wave optics and quantum optics. At present, there are more experimental contents of geometrical optics in Colleges and Universities. Due to the national conditions of our country, the experimental conditions and teaching materials of different colleges and universities are different, the shortcomings are also different, but in general, there are many problems in the allocation of experiment teaching hours. As a student, we should actively participate in the teacher's education, which not only to improve their theoretical level, but also their ability to think and to operate by themselves. But at present, the reform of teaching in Colleges and universities can not keep up with the actual needs of employers. Compared with the theoretical teaching time, the experimental class is obviously too small, however, institutions or research institutes pay more attention to the ability of students to translate theory into productive forces, which makes the students who have gone through the traditional education model into

a dilemma, not only students can not cultivate their ability to think and operate, but teachers can not achieve their desired teaching results. Therefore, one of the most important problems to be considered in the teaching reform of the application of optical design experiment is the limitation of time.

2.4 Students' lack of cognition on Experimental Teaching

We know that the purpose of college education is to provide the country with new-era cross talents with high quality, solid theoretical foundation and the ability to identify problems, mention problems and solve the problem .To achieve this, the content of teaching for students is far more than the single theoretical knowledge of the textbook , the teaching of the experimental design for the cultivation of students' ability is very important [8].However, in the teaching practice, we found that the vast majority of students aren't pay enough attention to the experimental teaching content, the application of optical design experiments that they understand is just following the steps on the textbook, or verifying the experimental data ,which are lack of thinking, so that it is difficult for students to produce real interest. Optical experiments have become a tool for obtaining credits. In the teaching content, the degree of emphasis on the experimental part is different. This makes it easy for students to fall into the theory and ignore practice, and even the wrong idea for examination. It is also has a negative effect on the cultivation of students' comprehensive quality, leading to the students' lack of competitiveness.

2.5 The backwardness of experimental teaching equipment

In recent years, the speed of the development of human science and technology into a geometric growth, optical research is no exception, correspondingly, the replacement rate of scientific research equipment also showed an upward trend [9].But at present, due to various factors, the department of optical experimental instrument in the vast majority of colleges and universities is still a lot of years ago, with different aging degree, making students in the teaching process can not contact

with the latest scientific and technological achievements, so that they can not understand the operating process and the using method of advanced instruments. It limits the students' thinking and makes them lose their competitiveness in employment.

2.6 Limitations of the experimental examination

Finally, the teacher should make an overall evaluation of the students' performance in the experimental class in theory, but in fact, because of the limitations of traditional teaching and learning mode, students just passively accept the teaching, weakening the initiative of the students, so it is difficult to truly reflect the overall performance of a student's level of practice. So that the teacher can only use the final test report as the main criteria for scoring. But when the students are writing report, we can not rule out the condition that in order to get high marks they learn from each other or copy others. It is difficult to evaluate the true level of a student, and it is difficult for teachers to evaluate the results. The results are often not objective and authentic.

3. The Direction and Suggestion of the Teaching Reform in Applied Optics Design Experiment Course

Reference to the successful cases of experimental teaching at universities around the world, combined with the actual situation and the training plan, we have applied optics design experiment course teaching system of thinking and exploration, and put forward the reform and practice. We will through the teaching reform, make our college students can improve applied optics theory foundation and practical ability, independent analysis related to our major project actual problem ability, at the same time stimulate students' innovation ability and learning interest, make them more competitive in the presence of unit of choose and employ persons:

3.1 Optimize the Teaching Structure and Establish the Teaching Goal

The clear and reasonable goal of teaching is the primary task to reform and

cultivate innovative talents. Course teachers in setting its teaching target, not only should consider the students' theoretical foundation, professional characteristics, and also consider the future employment direction and other factors, such ability according to different students to develop a variety of education plan, achieve the purpose of the multi-level education, the rational allocation of teaching resources, make limited teaching resources develop its maximum teaching effect. In addition, teachers in setting the teaching goal, their starting point can not be changed, which namely adhere to cultivate the students' comprehensive quality, the rational allocation of teaching hours and focus on cultivating students' ability of practice, thinking and innovation, transmission cross talent for the country.

3.2 Refine the core knowledge and optimize the content of experimental teaching

The reform experiment teaching content is the core and the key point that we carry out the teaching reform, directly relates to the cultivation of the student quality. Therefore, colleges should be combined with the actual situation, according to its own characteristics of scientific research and scientific research ability, write their own experimental teaching textbooks, to meet the needs of their own professional characteristics of student. To treat the experiment content, should take the essence to its bad piece, delete outdated content such as measurement and verification experiments, more innovative and independent design of inquiry experiment, to stimulate students' interest in learning, cultivate the students' innovation ability. At present, some colleges and universities are beginning to combine their own characteristics to write experimental teaching materials, which is worth learning and promoting. For specific experimental content, we can set up experiments in the field according to the students in different directions. For major students of white light interference, for example, we can set up the white light interference design experiments, cultivating their independent thinking ability, develop the practice innovation ability. Only reasonable experimental teaching content can be set up to lay

the foundation for further study.

3.3 Optimize experimental teaching mode

To optimize the experimental teaching model, we carry out the direct embodiment of teaching reform. The ultimate effect of experimental teaching depends directly on how the teaching mode is. Therefore, we should highlight the exploratory and innovative and optimize the traditional experimental teaching mode, break the traditional model of teaching and learning, to the centralizer student's main body status, let the teachers to return to guide and support role, so that the students through their own thinking and practice to explore the experiment. Even if there is no gain at first, teachers should step up and encourage students to keep their attitude to the experiment. To transformed the model of experiment for credit into interesting innovation. At the same time, the teachers should also strengthen the interaction with the students while giving the students the theoretical knowledge, so that they can bring the students into the classroom and actually integrate the experiment. Set up pre-study assignments for the students before the experiment begins. In this paper, the students themselves are asked to adjust the process of the experiment equipment, and they can point out the problems in the laboratory at any time, and answer the questions raised by the students .At the end of the experiment, students should be given ample time to review and reflect on their ability to participate in the experiment.

3.4 Open optical laboratory moderately

The moderately open optics lab is a follow-up to our teaching reform. As we all know, nowadays the social institutions and research institutes to talented person ability request increasingly improved, at the same time have a theoretical basis and the ability to experiment and inter-disciplinary talent in the enterprise competitiveness increasingly obvious. Therefore, it is the first task of universities to focus on cultivating the students' ability to innovate and explore. But now universities are setting up applications for optical experiments that are small in themselves, and only a

handful of optical laboratories open to students. This is not only detrimental to the achievement of the teaching goal, but also the development of students' exploration ability. In order to make students have more market competitiveness, universities should give full play to the spirit of serving the students, increase the intensity of optical lab is open to students, make the maximum use of resources.

4. conclusion

This paper through the investigation and study, understand the present status of experimental teaching the application of optical design at home and abroad, analyzes their respective advantages and disadvantages, and combined with the actual situation of our college puts forward the thinking of teaching reform and practice. Although the application of optical design experiment is just a part of the applied optics teaching, but the teaching effect is good or bad directly determine the cultivation of the students' comprehensive quality. With the deepening of teaching reform in recent years, the students' teaching environment will get a significant boost in various aspects, the students' ability and comprehensive quality will also get great development.

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